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ABSTRACT

The curriculum described in this manual covers basic skills and entry skills for electronics assembly and radio and television repair for both secondary and postsecondary instruction. The manual describes how the program is organized and gives objectives and exit points for the total curriculum. All of the tasks and units are listed with their relationships to one another. In addition to a curriculum description, the manual provides guidelines and hints for setting up and operating an individualized program. Setting up learning facilities, starting, and managing learning are viewed from an individualized instruction perspective. These sections, along with the selected references given, can be used as guides to establishing an instructional system using individualized methods. The important aspects of record keeping and grading are discussed and suggestions outlined for carrying out these tasks. The purpose of the curriculum is to train students to be able to enter business and industry at the entry level of the following occupations: electronics assembler, electronics utility worker, antenna installer, television installer, radio repairer, and television and radio repairer. The curriculum is designed so that accepted practices and procedures are incorporated as an integral part of the learning. (KC)

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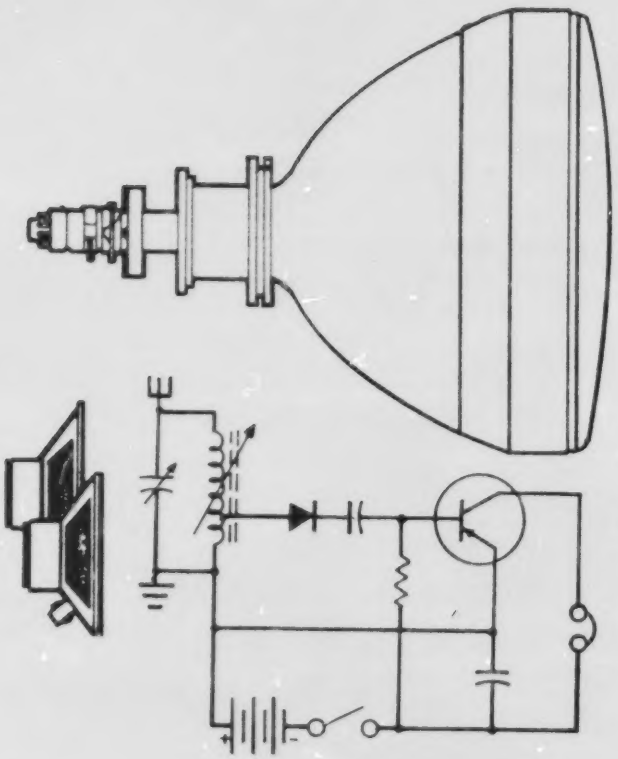

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GENERAL INFORMATION

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Developed and Produced
Under Contractual Agreement with

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Atlanta, Georgia 30334
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INTRODUCTION

The Electronics/Radio/TV program described in this manual has been designed to be used in both secondary and post-secondary schools. It is an articulated curriculum which allows students to move from secondary to post-secondary school without loss of continuity or credit.

The curriculum in the program covers basic skills and entry skills for electronics assembly and radio and television repair.

This volume of the teachers materials describes the make up of the curriculum and the instructional system around which it was designed.

3. OBJECTIVES

Program Objectives

1. To provide the skills necessary for successful employment in the fields of radio and television included in the curriculum.

2. To insure adequate knowledge of procedures used in Radio/TV repair occupations.

3. To instill the qualities of good workmanship and dependability needed by successful employees.

4. To provide each student with learning skills that will permit them to continue their education on-the-job and formally as it is needed.

5. To provide success in learning for all individuals who are capable of and can profit from vocational training in the electronics field.

Major Block: The Electronics/Radio/TV program is divided into basic and advanced courses. The basic course contains two blocks and is designed for two student exit points, electronics assembler and electronics utility worker. A model on page 16 shows how the exit points differ in terms of major blocks. The advanced course includes exit points for antenna installer, T.V. installer, radio repairer and television and radio repairer.

Block 10: This block contains the skills which enable workers to correctly identify and assemble electronic components and complete assemblies. Also included are tasks which teach the skills needed to fabricate chassis, order parts and construct PC boards.

Block 20: This block contains the skills which enable workers to correctly use test instruments to test components and completed circuits. Locating test points on schematics and/or assemblies and reading specifications are included as an integral part of the tasks.

Block 30: This block contains the skills needed for workers to install and repair systems. Finally, the basic skills needed to estimate the cost of materials and installations are included.

Block 40: In this block the skills needed to install and adjust radio and television receivers are combined with tasks which teach a worker how to instruct customers in the use of customer controls in obtaining the best reception possible.

1. HOW TO USE THIS DOCUMENT

This volume of the teachers' material can be used to plan and implement an individualized program in electronics/radio/TV. The manual describes how the program is organized and gives objectives and exit points for the total curriculum. All of the tasks and units are listed with their relationships to one another. Using this information, an instructor will be able to develop the needed information to describe a program and courses for that program. The task listing, units and exit points will allow him/her to describe the content and sequence of learning for courses and a program.

In addition to a curriculum description, this manual provides guidelines and hints for setting up and operating an individualized program. Setting up learning facilities, starting and managing are viewed from an individualized instruction perspective. These sections, along with the selected references given, can be used as guides to setting up an instructional system using individualized methods. The important aspects of record keeping and grading are discussed and suggestions outlined for taking care of both of these.

2. PURPOSE

The purpose of the Electronics/Radio/TV curriculum is to train students to be able to enter business and industry at the job entry level of the following occupations.

Electronics Assembler
Electronics Utility Worker
Antenna Installer
Television Installer
Radio Repairer
Television and Radio Repairer

The curriculum is designed so that accepted practices and procedures are incorporated as an integral part of the learning. The curriculum materials provide learning for the tasks needed to master basic servicing skills and also to allow for each instructor to supplement units with problems which will help students prepare for the jobs available locally.

BLOCK 50: In this block three major areas are emphasized (1) basic principles of radio, (2) functions and operation of each stage, (3) troubleshooting and repairing receivers. Emphasis is placed on transistorized receivers.

Block 60: In this block radio repair is extended to FM receiver. AM/FM receivers are also covered at the end of the block.

Block 70: In this block of instruction students will learn how to service, troubleshoot and repair record changers.

Block 80: In this block students learn how to repair and service tape recorders and playbacks.

Block 90: The tasks in this block are designed so that students gain experience in repairing and servicing home entertainment centers which combine radios, record players and tape players. Additional theory and more advanced test procedures are covered.

Block 100: This block contains the skills necessary for a student to repair all types of television receivers. Emphasis is placed on current color receivers and using manufacturers' references in servicing.

4. EXIT POINTS

The tasks in this program are arranged to allow a student to exit at the following points. Although other occupations may be contained in this program, only those recognized by D.O.T. code are listed.

	Occupation	D.O.T. Code
Basic		
1.	Electronics Assembler	726.684-018
2.	Electronics Utility Worker	726.361-010
Advanced		
3.	Antenna Installer	823.684-010
4.	Television Installer	823.361-010
5.	Radio Repairer	720.281-010
6.	Television and Radio Repairer	720.281-018

5. CURRICULUM STRUCTURE OVERVIEWS

Why Individualized Curriculum Was Developed: The curriculum described in this manual is different from a traditional design in many ways. To understand these differences it may be helpful to know the objectives toward which the design was aimed. Originally, several problems in Georgia's Vocational Schools led to an attempt to meet the following objectives.

1. Design a curriculum delivery system which will allow students to enter a program where they have needs and leave whenever these needs have been met.

2. Increase the utilization of the facilities and equipment of a school by increasing the number of student-hours each year.

3. Allow students to learn as fast as they are capable of learning.

4. Have enough flexibility to successfully handle individual needs and goals.

The curriculum content of this program is based on a traditional analysis of the occupations in Electronics/Radio/TV The delivery system employed is not traditional; nor is there a claim made that the curriculum is individualized in the modern sense. The delivery system and curriculum design can best be described as a planned instructional system for individual learning. The materials are multi-media with the instructor functioning as a manager of learning and an important instructional aid. He/she is not only "programmed" into the learning activities, but is also always available when the planned activities are not adequate for an individual's abilities.

Key Advantages of Curriculum Design: Whenever and wherever possible materials are used which are similar to those which the student will use on the job. A dual purpose is served by this policy. First, the student receives the needed instructions and second each learns how to use the materials.

The school's facilities and equipment receive greater utilization from the fact that the enrollment per hour tends to increase and the hours of use per day also increases. No longer is there a need for a minimum number of students locked together at the same point in the program. The minimum number still is required, but their position in the instructional sequence is determined only by their progress. There is no need for even two students to be learning the same skills at any one time.

By this same fact there is no need for any student to wait on another to progress before moving on, nor is there any reason for a student to move on before having accomplished the specific instructional objective. Time becomes an individual characteristic. Each person uses as little time as needed to learn.

Because of the non-dependence of one student on another, the instructor can tailor a program to fit an individual's personal needs and as the system develops and expands, the system will react to more individual learning needs.

A. GENERAL PROGRAM CHARACTERISTICS

Planned Instruction: When students begin a program, all the tasks which they will try to complete are planned so that there is no question about what they have to do to reach the final objective. All of the necessary materials they need for work are stored for easy access. They know what to use, when to use it, and where to find it. Although it is possible to change or add to the basic program, it is not necessary except when a student has a special goal.

Job Oriented: The ultimate goal of this program is to make sure the student training in the program will be able to successfully enter and work in an Electronics/Radio or TV trade. To help make sure this happens, several guidelines have been written.

1. The tasks each person learns are as close as possible to the ones done on the job. The objective for each task is based on what will be expected on the job and the standards set for shop work are in terms of occupational standards.

2. When it is possible, manuals and other training materials which will be used on the job are also used as learning resources. A hidden but important reason for doing this is to train the student in correct and effective use of these materials.

3. Throughout this program, there has been an attempt made to instill the habits and attitudes into individuals so that they may be successful in their jobs. These include safety, workmanship, punctuality and self-discipline.

Motivational: This program is designed to be self-motivating as compared to a group-lecture method. Motivation is helped by two important characteristics of the program. First, the tasks students work on are related to what they want to do in the future. Second, each student can learn as fast as possible. No one is held back by being forced to go at the pace of the slowest student in a group.

In addition to this, the learning is organized so that the related knowledge is learned as close in time to its application as possible. Whenever it could be done, Math, Science, and English skills needed for a task are treated in this way. Section "C" of this manual goes into more detail about how this differs from the traditional programs.

Ease of Entry and Re-entry Into a Program: This program is set up in individual instructional units so that persons may easily enter and exit from the program as it is necessary. They can do this without losing credit for past work. This will, of course, always depend on the program's openings and the instructor's judgement.

B. SPECIFIC PROGRAM CHARACTERISTICS

Curriculum Design: The Electronics/Radio/TV program is designed so that there are many points where an individual can enter and leave the program successfully. This design provides for the different combinations of skills and levels of proficiency needed in various occupations.

If they had no prior knowledge, the starting point would be the same as the typical student, but the path through the program would follow only those tasks needed for their specific occupational goal. If they had prior experience and could demonstrate proficiency in basic skills, they would be able to enter at an advanced level and complete only those tasks in which they were not already proficient.

Because of the unit or module structure of the curriculum and the attempt to eliminate unnecessary prerequisites, the curriculum design used allows individuals with prior training and experience to satisfy needs which relate only to advanced study or updating of skills.

C. T & I CURRICULUM STRUCTURE (OLD & NEW)

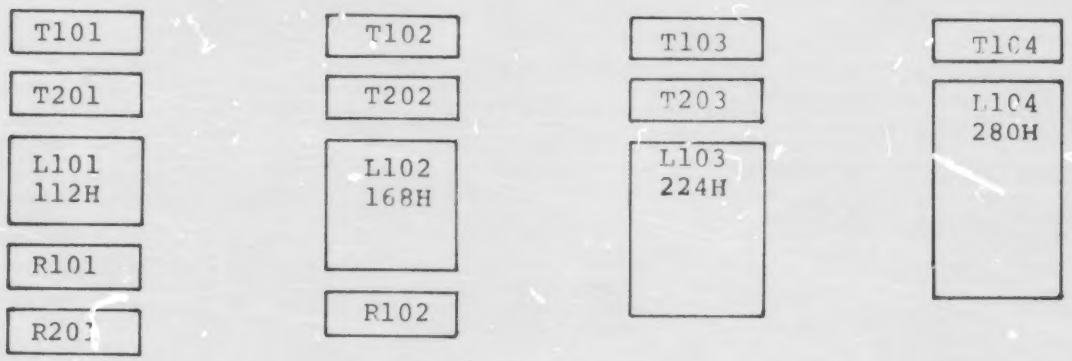
The typical T & I curriculum has traditionally been broken into 56* hour blocks or multiples thereof. These blocks are arranged into quarters by combining six of the 56 hour increments to make a six hour school day.

56	THEORY	(Knowledge 101)
56	THEORY	(Knowledge 201)
112	LABORATORY	(Lab 101)
56	RELATED	(Gen. Related 101)
56	RELATED	(Job Related 101)

Figure 1 Typical Yearly Quarter

A student who enters begins with the most basic theory course and, after acquiring the theory and related courses, begins laboratory courses which teach the manipulative skills and occupational application of what has been learned.

In a typical program, the amount of theory and related material will decrease during the year and the hours for practice and application will increase.



T - Theory
L - Laboratory
R - Related
56 hours represents a one hour course

Figure 2 Typical Yearly Curriculum

The procedure for arriving at the content for each of these blocks has been to perform an occupational analysis. The output of the analysis, in terms of the skills and knowledges needed for each task, are grouped into common areas or courses.

*56 hours represents a one (1) hour course taguht for one quarter 56 days in length

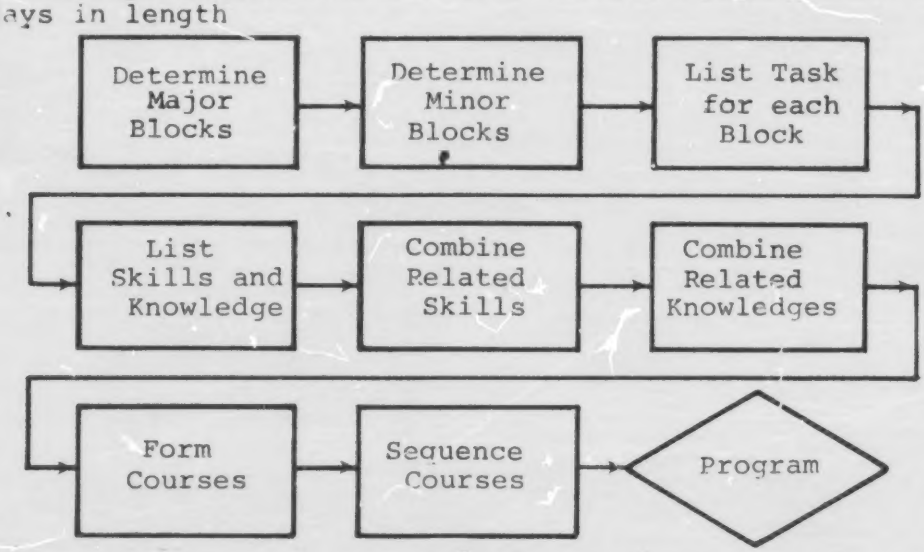


Figure 3. Basic Steps in Program Design

Looking at this process critically, you can see some situations which occur that are not the most desirable from a learning and motivational standpoint.

The determination of major and minor blocks and listing of the tasks in an occupation are essential first steps in any analysis. Although major and minor blocks are not always a necessity, the listing of the tasks performed in an occupation is the only realistic basis for developing training for that occupation. The skills and knowledges needed for each task are also essential information in planning the training program for an occupation. The major problem comes when these skills and knowledges are combined to form courses and the courses must be sequenced because of the requirements of hours and quarters. Looking at the typical yearly curriculum illustrated previously (Figure 2), notice the high concentration of theory and related courses in the first quarter. This is generally true because the beginning tasks require some knowledge of several different theory or related areas (i.e. T101, R101, R201). This means a student must study a great amount of theory which may not be applied for several months.

The situation is not motivating because in many cases no reason for learning the particular information is evident and the learning of theory only is too reminiscent of past educational experiences which were not always successful or satisfying. Since the application of the theory (the performance of a task) is not near in time to the theory, there is sometimes a loss in retention of the theory when the task is later attempted. This development would force the students to relearn the necessary information before they could accomplish the task. Sound learning theory suggests that the application for theory should be as close as possible in time to the theory in order to reinforce the learning.

It is also possible that in some cases, because of the scheduling structure, theory needed for an early task may not be taught until after the task has been accomplished (i.e., the manipulation involved hasn't been learned).

Under this traditional structure a student who is unable to stay with the group must either "drop-out" or spend many additional hours "keeping up" or "catching up". In either case, the situation is less than desirable.

For a student who does not enter with the group there are several possibilities. If students enter on a quarterly basis and there are several teachers available, each group would be conducted as above (provided adequate space and equipment are available). If students are accepted on a random basis, the instructor may try to catch them up to the group which most recently entered and then move the group along as before. In either case the typical structure does not lend itself to solving these problems.

With a curriculum based on an arbitrary time frame there is always the possibility of either having too little time and missing some important concepts or having too much time and holding a student who could already be gainfully employed.

In many instances the curriculum structure already discussed was based originally on a task analysis. However, the analysis lost some of its usefulness when it was dissected and recombined into large related blocks.

Without discussing the many reasons for moving to a new curriculum structure, the following discussion will point out the differences between the two designs and the evolutionary process from one to the other.

As mentioned before, the starting point for both curriculum designs is essentially the same. An occupation is broken down into major and minor blocks, where convenient. For each block the tasks are listed which are necessary for successful employment. Each task is broken down into what must be learned to successfully accomplish the task and the learning required is sequenced into the proper order. The tasks themselves are then sequenced where prerequisite listing is necessary. Where sequencing is not necessary the tasks are ordered in a logical manner.

The curriculum structure is now a listing of individual blocks of instructions which are very seldom rigidly sequenced. The block, when developed, will contain all the skills and knowledges needed to accomplish the task contained. These skills and knowledges will be learned as they are needed in conjunction with the task.

In the beginning phases of implementing a curriculum structured in this way, each student would begin with block Unit 101-1. The material for this unit would be individualized so that a student could enter at any time without upsetting any other student's learning or adding unnecessary hardship to the instructor. At this stage of implementation students would proceed through block 101 then move to block 102 and continue until they had completed all of the blocks necessary to lead them to their goal. Figure 4 depicts this sequence.

Figure 4

In this stage students continue to enter at block 101 and follow the same flow until they reach a decision point. Because the units in each option are individualized, the number available in the same program is controlled only by the number in the occupation and available equipment and materials.

At this point students continue to learn all the basic and advanced units before choosing an option. This does not leave out the possibility of students being given advanced standing or skipping units which they have previously mastered.

Figure 5 illustrates the addition of options to the basic program.

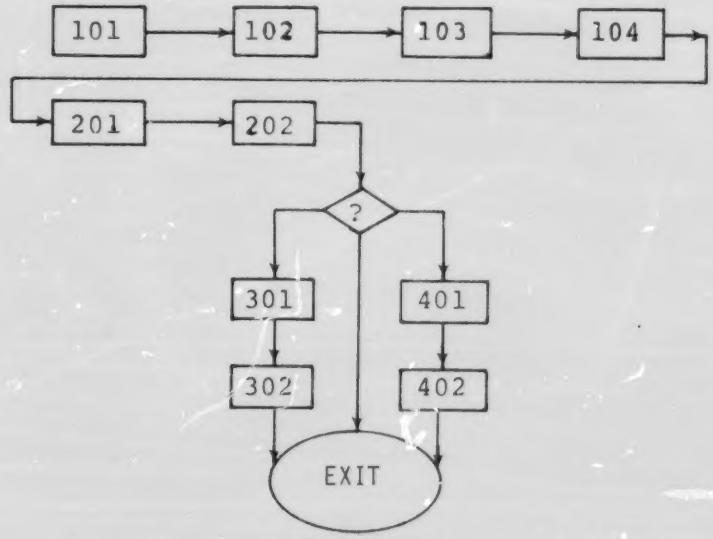


Figure 5

After the initial stages of implementation have been tested and modified as necessary, the curriculum structure can be used so that many different paths for student progress are available. The more self-contained the units are, the more flexibility there is in moving through the tasks to desired objectives. In many cases all of the basic and advanced units are not required for each successive task. It may be for reasons of equipment use, student interest, available live work or student goals, that only a few basic tasks are needed before a learner moves to more advanced levels.

The instructor is now able to design a special program of study for each individual if the need arises. An entering student is able to specify needs when entering, and the instructor can prescribe only what is necessary to meet those needs. Applying this structure to the meeting of various goals will require that many different occupational specialties be analyzed so that only the tasks needed for that job are listed and sequenced. From time to time special additional tasks must be developed to fill voids in the original structure. These will allow for new options and allow by-passing of some task not needed for a special goal.

Figure 6 shows three different entry points, learning paths, and exit points within the same sequence of learning units. The size of the squares in the Figure illustrates the differences in time or amount of content between units. No attempt is made to keep these constant, but the content is dictated by needs of the task to be learned.

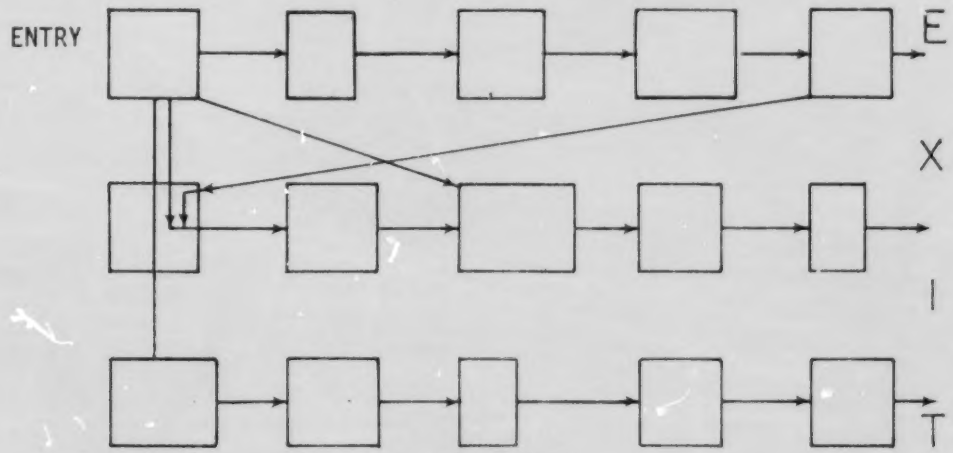


Figure 6

To reach the final stages in implementation of a truly flexible curriculum several steps are necessary.

1. The total curriculum for the single occupational program must be developed and implemented on an individualized basis. All learning must be planned and sequenced, all materials must be developed and tried, and each unit must be tested.

2. Different options must be analyzed and developed the same as the original program.

3. All units must be inventoried in such a way that the instructor can prescribe them on the basis of ultimate goal and prerequisite tasks.

4. A method of keeping track of daily equipment utilization must be developed so that prescribed tasks can be performed when needed.

5. Additional units and materials must be developed and tested as new needs arise (needs of both student and industry).

These requirements imply that the development must be continued indefinitely and the final structure will evolve as needs dictate its form. The ultimate system will be characterized by the following:

1. Students will enter whenever they have needs and space is available.

2. Students will exit whenever these needs have been met.

3. Students will progress through the curriculum by the path which most nearly fits their needs (as determined by the instructor).

4. At any one time it will be possible that no two students are working on the same task or equipment.

5. The facilities will be available for use during a major portion of the day.

6. Meeting new needs will not require a total curriculum overhaul, but only additions and slight modifications.

When these characteristics are present, the needs of individuals and industry will be met on a continuing, more realistic basis, and the facilities of the schools will be utilized on a more efficient basis.

6. TASK LISTING

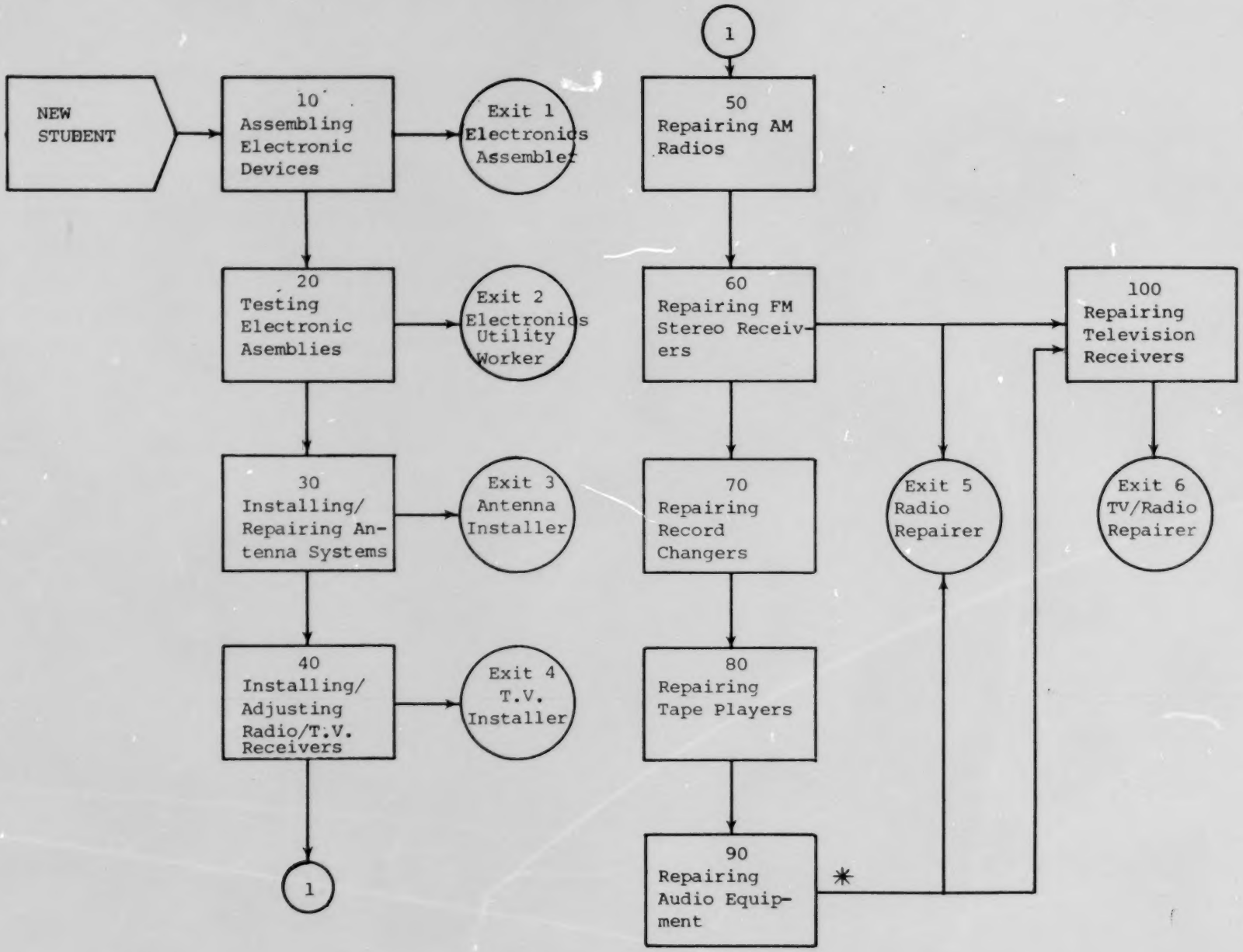
TASK NO	TASK
11	Fabricate/Assemble Structural Components
12	Identify and Mount Electronics Components
13	Solder/Unsolder Components
14	Splice Wires and Cables
15	Order Stock Items
16	Constructing P.C. Boards
17	Fabrication Project
21	Measure Total Resistance
22	Measure D.C. Output Voltages
23	Measure D.C. Output Current
24	Measure in Circuit Parameters
25	Measure Power
26	Measure A-C Voltage and Frequency
27	Measure Phase Angle
28	Determine Resonant Frequency
31	Select and Install Antennas
41	Deliver, Unpack and Install Receivers
42	Adjust Receivers for Best Reception
51	Repair AM Radio RF Section
52	Repair AM Radio TF Section
53	Repair AM Radio Audio Circuits
54	Repair Radio Power Supplies
55	Troubleshoot and Repair AM Radios

TASK NO	TASK
61	Troubleshoot and repair FM Circuits
62	Align FM Receiver
71	Service and Lubricate Record Changer
72	Repair Record Changer Drive Mechanisms
73	Repair Record Changer Change Mechanisms
74	Repair/Replace Tonearms, Needles and Cartridges
81	Service and Lubricate Tape Recorder
82	Repair Tape Transport
83	Repair Record System and Microphones
84	Repair Playback Systems
91	Repair Audio Amplifiers
92	Repair Speaker Systems
93	Repair Home Entertainment System
101	Prepare T.V. Receiver for Service
102	Remove/Replace and Set-Up a Color Picture Tube
103	Repair Low Voltage Power Supply
104	Repair Tuner
105	Repair Vertical Sweep
106	Repairing Horizontal Sweep Problems
107	Repair High Voltage Circuits
108	Repair Sync Separator Circuits
109	Repair Color Sections
110	Repair Video Circuits
111	Repair Sound Section
112	Repair T.V. Receiver

7. BRANCHING OPTIONS

The curriculum has been structured so that all of the basic units contain examples from several options whenever it is possible and practical. The diagram on the following page illustrates how the major blocks of instruction are arranged and sequenced to provide a path for each exit point.

There are alternate paths and you will find that only selected tasks may be needed for specialized occupations. As you use and alter the curriculum to fit those jobs in your vicinity more possibilities will emerge.



*There is no DOT code for audio equipment repairer.

8. PROGRAM OPERATION GUIDELINES

A. ORGANIZING AND MANAGING THE LRC

The LRC or Learning Resource Center in an individualized instructional program takes the place of the classroom in the traditional group taught program. It is the center of all activities that are not manipulative and its proper set up and functioning is essential to any efficiently run program. Before beginning on this section, it would be helpful to read the selections listed below if they are available.

Installing and Operating An Individualized Instruction Program. Vocational Curriculum Center, Georgia State Department of Education. Pages 27 through 31, "LRC and Study Area Checklist."

Arrange for Improvement of Your Vocational Facilities, Module E-3. The Center for Vocational Education, Columbus, Ohio. Pages 6 through 13, "Improving Your Vocational Facilities."

Organize the Vocational Laboratory, Module E-8. The Center for Vocational Education, Columbus, Ohio. Pages 11 through 12, "Instructional Resource Center."

In these three selections you will find ideas and check lists for evaluating your present and future LRC. In the following discussion we will progress through the functions of an LRC and how these functions will be provided for. Finally, we will present a list of steps to take in designing and laying out your LRC and setting up a numbering and filing system.

Purpose of an LRC

The LRC (learning resource center) has been the object of much discussion and large amounts of money have been spent on building and equipping it. The questions should be raised and properly answered as to why such a facility exists. The objectives it fulfills or needs it satisfies are fundamental prerequisites to its existence. It is probably more easily described in terms of the needs it meets.

In group instruction where a classroom is available and students are working in step with one another, space is provided for reading, studying and all other activities except those to be done in a shop or laboratory. In an individualized instructional setting there must be an area for the same activities and additional areas not always needed in group instruction.

Generally these activities include:

Reading
Studying
Answering questions
Working problems
Looking and listening to audiovisuals
Using references
Doing research
Discussing ideas
Thinking over problems

The instructor also needs a place in which to discuss ideas, problems and solutions with one or more of the students. Because all of these activities are necessary, there must be an area provided for them in the instructional facility. Because of the other functions associated with the LRC, an instructor's area can be fitted in so that he or she is still in continuous eye contact with the students.

Sometimes the title LRC conveys the impression that storage is a primary function of this area. Storage is provided only to accommodate the functions of the LRC. By studying the list of activities to take place you will be able to see that certain characteristics of the LRC design emerge. First, all of the activities to be performed need a quiet surrounding with a controlled climate. The area needs to be protected from dust, dirt and other shop and laboratory products. Next, the LRC needs to be well lighted for reading, writing, sketching and related work. The center needs to be close to the lab so that unnecessary time is not lost in transit to and from lab or shop. While it should be isolated acoustically from live work areas, it should be visually accessible from any position in the entire instructional area. While the instructor is in the LRC or shop he or she is still responsible for students in the other areas, and therefore, must be able to retain visual contact at all times.

It would seem then that, ideally, the LRC should be as close to the center of the lab as possible, cut off from the shop acoustically but not visually. Practically, a room or partitioned area as close to the center of the shop as possible is as good as we can expect. This is true as long as the partitions or walls are fitted from at least waist high to about 7 feet with glass or plastic.

By considering what the students will be doing in the room, you can begin to see how the room should be furnished and equipped. Since it would be impossible for the students to carry all of their learning materials with them from place to place, they should be available in the LRC and this dictates the storage functions of the center. Storage is needed for texts, references, manufacturers' manuals, audiovisuals, and other related items. In addition, both storage and space for the audiovisual equipment is needed.

The students will also be reading, writing and doing other activities which require desks or tables. Past experiences have shown that regular student desks are not as well suited to the needs of this center as round or rectangular tables and individual chairs. This type of arrangement provides flexibility for use with small or large groups as well as its primary functions for individualized instruction.

On page 26 of Installing and Operating An Individualized Instruction Program you will find two examples of functional LRC's.

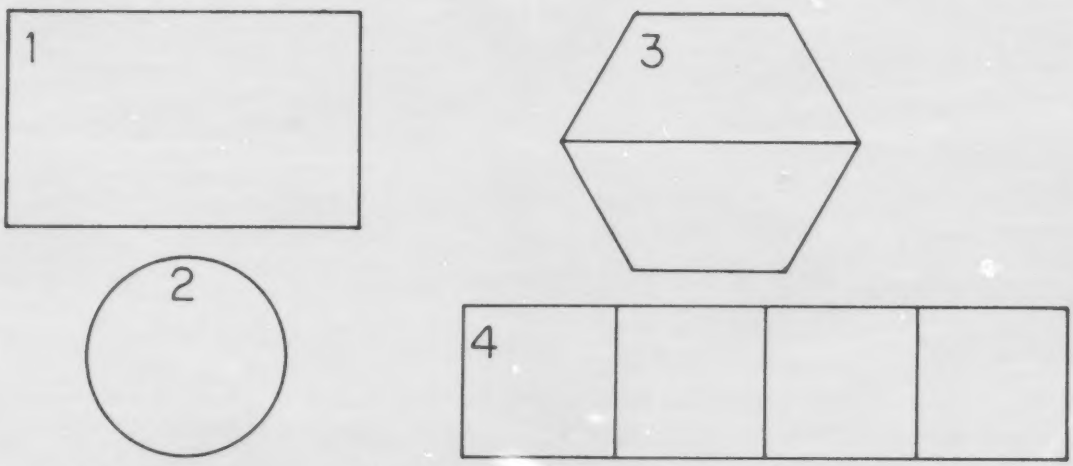
Contents of An LRC

In the previous discussion we mentioned what general types of space and functions are contained in the LRC. Now we need to look at these needs more specifically. First, we will look at the furnishings needed and then at the audiovisual equipment and accessories necessary to operate an individualized program on a minimum level.

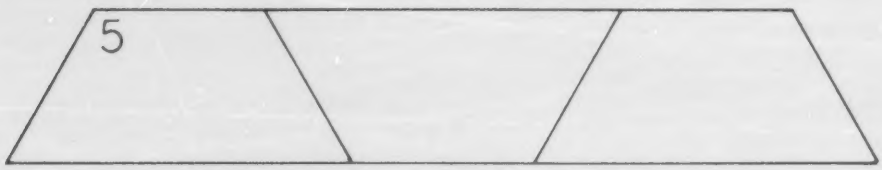
Study Area

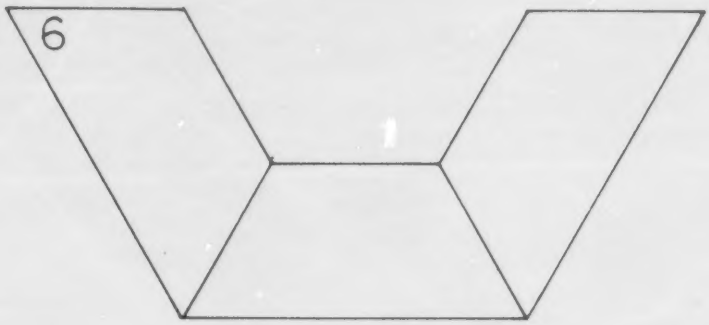
Past experience has shown that only about one-third of the total student population needs access to writing or reading space at any one time. To be on the safe side you may want to provide writing spaces for one-third and then add a few spare chairs for reading only and small discussion groups. In terms of actual numbers, let's consider 24 students to be the maximum ever to be expected at any one time. This is too many for one instructor to handle on a regular basis, but this number might occur when some students are nearing the end of their programs and new students are being phased in. One third of 24 would be 8 writing stations. If we provide, in addition to that, 6 spare chairs we will have 14 seating positions which would accommodate one-half of the maximum load and two-thirds or more of the normal load.

There are many configurations and styles of tables available for these positions. The illustrations following show some of the possibilities.



Configurations 1 and 2 are standard tables placed away from walls so that there is access to all sides of the table. Arrangement 3 utilizes two of the now popular tables that can be arranged in many different designs. By placing these tables together as shown below they can be used on a wall in diagram 5 and as a small group discussion area with a moderator as shown in figure 6.





Arrangement 4 is for use on a wall where dividers are desired to provide more privacy. Using the type of spaces in figure 4 provides additional audiovisual carrels if needed. Where space is at a premium they can be used either as one or the other and counted as both, thereby reducing the total number needed.

Audiovisual Stations

In completely individualized programs that are heavily mediated only about one viewing station for every 8 students is needed. This applies only if one primary type of media, such as slide-tape sets, is used in the program. In that case, for our hypothetical class of 24 students, 3 viewing stations for slide-tapes will usually be enough. In addition to this, you will need to provide a station for every other type of playback equipment you will be using. The type and amounts of media you will be using will dictate your final needs.

Where heavy use of slide-tape sets depicting the steps of an operation are utilized, it is beneficial to have one portable carrel or viewing station so that the presentation can be viewed at or near the actual job.

Accessories for each of these stations should include at least two sets of cushioned headsets with individual volume control and a "Y" adaptor so that a playback of an audiovisual set can be viewed by more than one student at once. There should be one listening station in each LRC that will accommodate at least 8 headsets. Always keep at least two spare bulbs per projector.

Materials Storage

Many unique and novel devices are available for storing written and audiovisual materials. However, for ease of inventory, accessibility and low cost, open shelving is satisfactory for all items except cassette tapes. These should be stored in some sort of drawers or stacked units. In any case they should be so arranged and labeled that any missing items can be detected easily.

To estimate needed space you will need some idea of the number and size of written materials and audiovisuals. Then a simple total of linear feet will allow you to design a tentative storage unit.

One unit that should always be included in an LRC is a letter or legal size filing cabinet. Much of the information needed by the student is most easily stored in folders. The only efficient way of storing and retrieving folders is with a filing cabinet.

Planning the LRC

Before you determine the size of the LRC or the arrangement of its interior, you must have a list of the contents of the LRC. You will also need the dimensions of these items and their electrical requirements. After these items are known, you can plan and implement your ideas. We will first go through a step-by-step procedure for planning your LRC. As you follow these steps you should consult the checklist in Installing and Operating An Individualized Instruction Program. After you have completed the final plan, again consult this list as a check.

Remember, make plans for what you think will best fit your needs and then make adjustments to fit your resources. Never discard your "best" plan, but use it as a guide for future improvements.

Selecting Furnishings: Don't worry about arrangement at this time. Concentrate on furnishings and storage that will best fit your needs.

1. Estimate the number of each kind of station that you will need. Label these stations as to their use and then estimate the number needed.

Example 1

Studying and Writing	8
Reading/Small Group	6
Audiovisual Viewing	3

Example 2

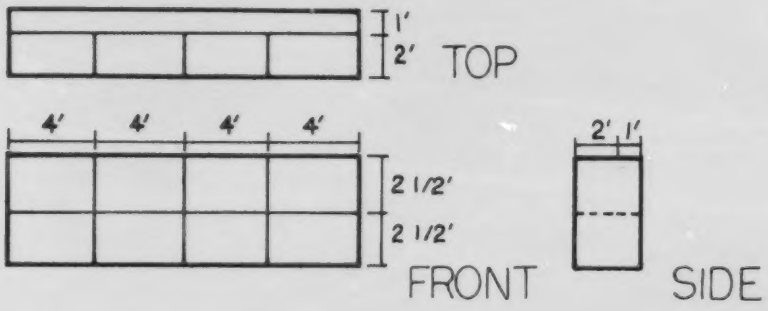
Studying/Audiovisual	8
Reading Only	4
Small Group	10

The number will depend on the maximum number of students in the program and the extent to which media, written assignments and studying will be done.

2. Sketch the furnishings you want to use. Be sure you have the dimensions of the top view of the furnishings as accurate as possible.

Example 3

Carrels for study/audiovisual viewing



You should sketch each type of furnishing to be included in your LRC. If electrical connections are needed, be sure to show this on the sketch.

3. Estimate the space you will need for storage of instructional materials. Below are some estimates you can use and some points to remember.

FOR ELECTRONICS/RADIO/TV PROGRAM:

Example 4

Slide boxes store in about 4 feet of shelf space.
Eight MM loops in boxes store in about 6 feet of shelf space.
Estimate books at about 8 feet of shelf space.
Current periodicals should be stored in a magazine rack type storage showing the front of the magazines.
Back issues of periodicals can be stored on shelves in boxes.
Cassette tapes are best stored in drawers where they can be quickly inventoried.
Don't forget at least one filing cabinet.

First, list the amounts of all the materials you will need and then estimate the space needed. By consulting office equipment and school equipment catalogs, you can get a good idea of sizes and available units. From these and from what you have seen in other programs, design units which will fit your needs. The rationale might be as follows:

Example 5

31 filmstrips
112 slide sets
31 8 mm loops
152 cassette tapes
200 reference manuals
150 pamphlets
6 current periodicals
12-3" boxes of magazines

Shelf Space:

112 slide sets ÷ 4/ft. = 30 feet*
195 reference manuals ÷ 8/ft. = about 40 feet*
(*at least 74 feet of shelving is needed)

Storage Cabinets:

In an equipment catalog you find a storage cabinet that will hold cassette tapes, 8 mm loops and filmstrips. You copy the specs and prices. The cabinets stack together and have the same top dimensions - 20 5/8" wide X 17 7/8" deep.

31 filmstrips - 1 drawer 4 5/8" high holds 100 filmstrips $46.00
31 8 mm loops - 1 drawer 7 3/16" high holds 60 8 mm cartridges $60.00
152 cassette tapes - 2 drawers 10 1/4" high holds 160 cassette tapes $104.50

You decide a 30" high table will be needed to hold the cabinet.

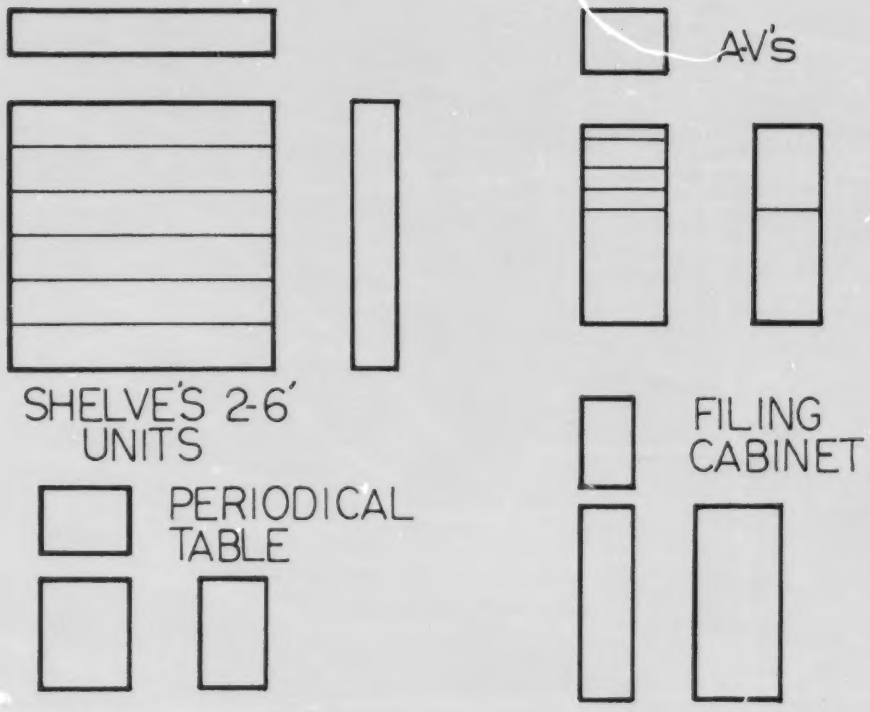
Filing Cabinet:

You decide on a four drawer letter size filing cabinet for the pamphlets. The dimensions of the cabinet are 25" deep x 15" wide x 52" high.

Other:

You decide to use a small table 18" x 24" for current periodicals and any new information that arrives. This will be a place for students to check on occasionally for new information in the field.

Next, you should sketch all of your storage units. Below are sketches for the items described on the previous page.

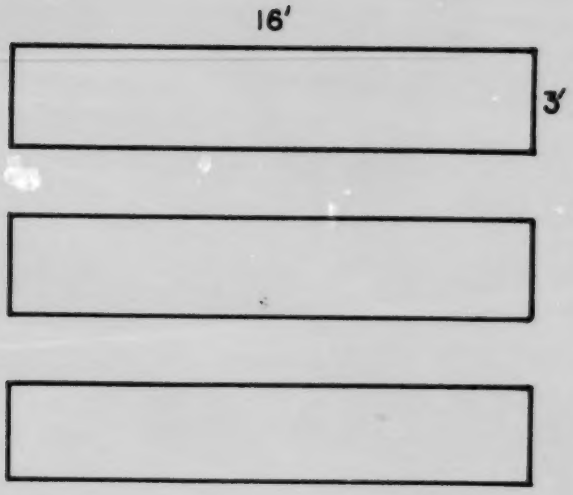


4. Now you are ready to lay out your LRC. The procedure we will use is one which architects, engineers, interior designers and others rely on. We will use a simple version of this procedure for the LRC.

You must first decide if you are going to use an existing space. That is, has your floor area already been determined for you? If you have some flexibility in the size of your LRC, it will be easier. In either case the same procedure can be followed.

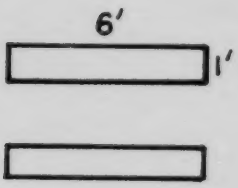
A. The method we will employ uses a grid sheet and scaled cut outs of all the furnishings to be placed in the LRC. The first step in the procedure is to list all of the items to be placed in the LRC. There is no need to draw them to scale at this time, but simply list them and make a top view dimensioned drawing.

CARRELS

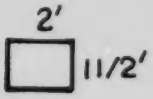


DISCUSSION TABLE

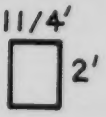
SHELVING



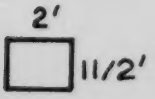
A-V DRAWERS



FILING CABINET



PERIODICAL TABLE



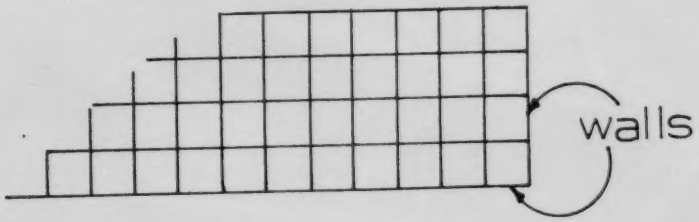
B. Next, draw each item to scale. Following are some hints that might help you.

Grid paper of 1/4" grids is available in most locations. With this in mind, a scale of 1/4" - 1' is a good choice. If you don't have a rule with a special 1/4" scale, it is easy to use any ruler for this increment. Make a solid black line around each silhouette you draw. It is best to use card stock for your cut outs, since they receive a lot of handling.

C. Now label each cut out and add any special information if there is room on the drawing. For example, you would want to remember that the carrels you are using have backs that could be placed either against a wall or against another carrel.

If you can't get the information on the cut out, make notation such as (1) and have a legend with notes.

D. When you have finished all of your drawings and labeled them, you are ready to arrange them in your LRC. If you are planning for a new space, start by drawing a corner and work from there to determine how much area will be required for this new space.



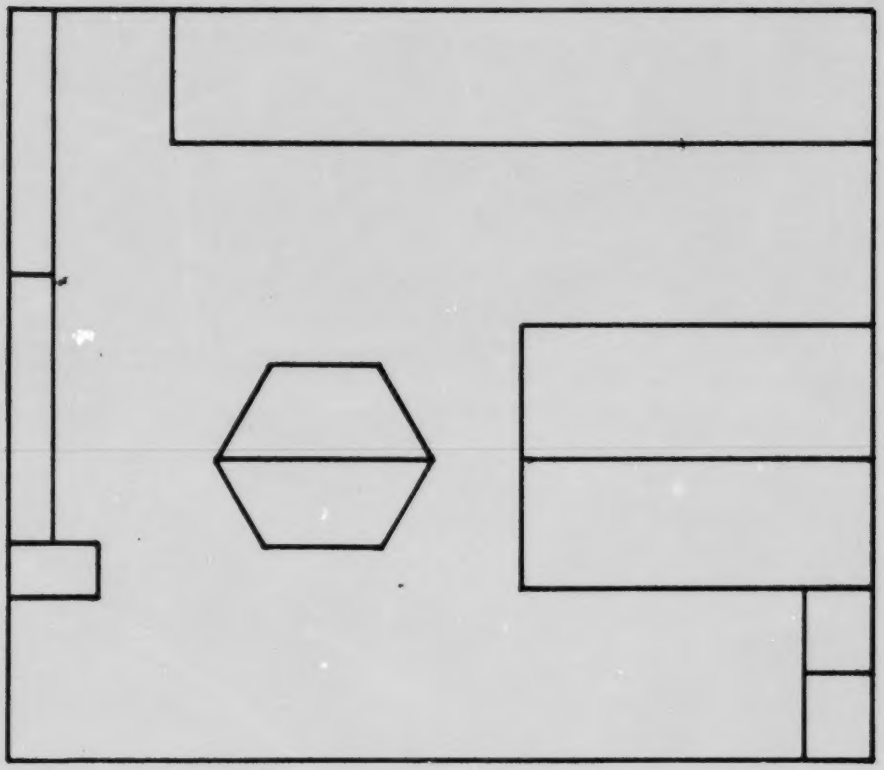
If you already know the area you must use at present, use it for now, but always keep a plan for the future. Draw the existing space on the grid sheet.

E. Now carefully cut out your outlines. You may also want to cut out some silhouettes for aisles or other areas to be kept uncluttered.

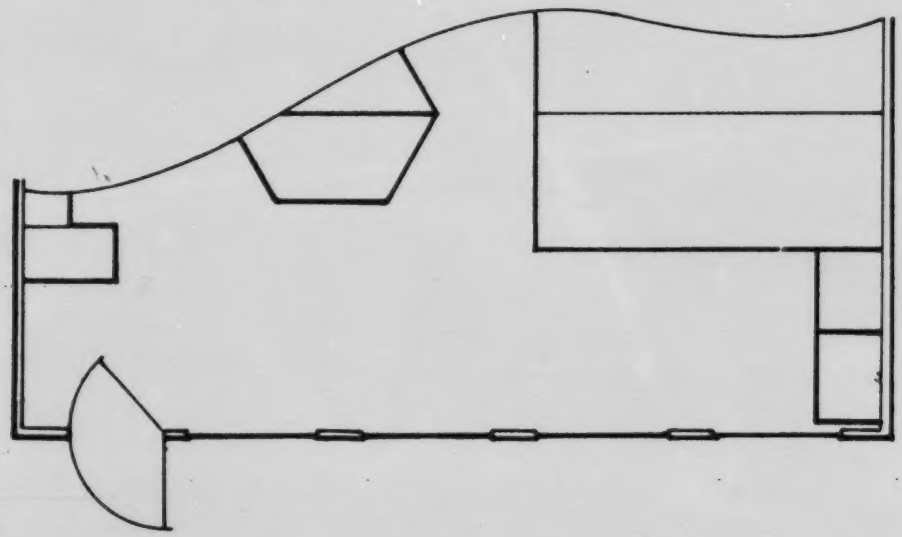
F. Now lay out your LRC. When you get an acceptable arrangement, sketch it on another grid sheet. Then, make another layout. Continue this process until you arrive at several arrangements with which you are satisfied.

Compare your layouts against the lists given in the references. Discuss them with other instructors and your supervisor. After you have settled on a plan, you should make a list of what you need to do to accomplish this plan. Each item listed should be detailed and the cost of carrying it out estimated.

When you have done this you are ready to present it to the administration.



G. Now draw in doors, windows, etc. This may eliminate some of your layouts.



Marking and Filing Instructional Materials

Every piece of instructional material you have for use by students should be properly labeled, catalogued and filed where it can be easily retrieved when needed. It is better to let the student do as much of the acquiring and filing of material as possible. This procedure is part of a learning process in itself. It will also relieve you of the repetitious work that takes you away from more important duties.

Those materials which come with the program must be labeled in the same way in which they are referred to on the unit sheets. This includes all texts, references, and audiovisuals needed for the program. For other materials which are for use in the program, but not specifically called for, the following method has proved successful and efficient.

Since the Electronics/Radio/TV curriculum uses a coding system which refers to task, you should consider using the same numbering as your filing system. As you know by now, the Electronics/-Radio/TV program is divided into 10 major blocks. Each block is broken into tasks and these tasks are numbered.

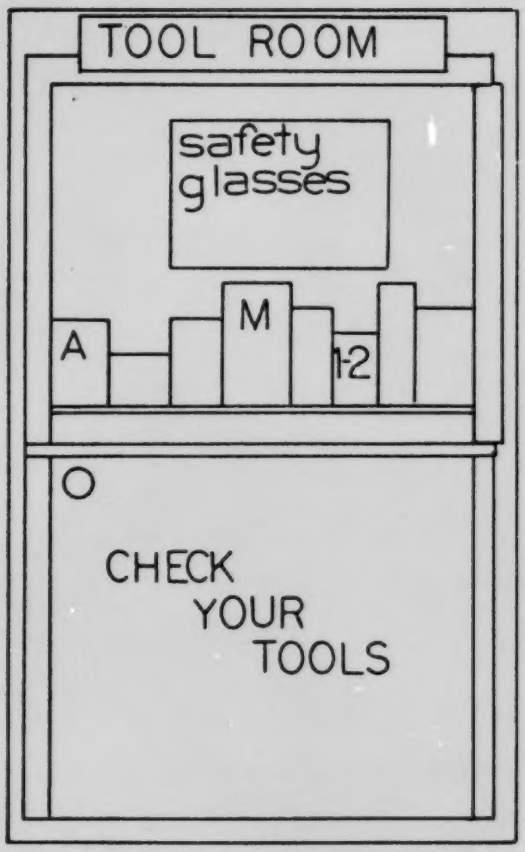
In addition to selecting and using a numbering system for subjects, it is also important to identify each item uniquely. The permanent storage location of each item should also be labeled and recorded. In that way you can tell if an item is in the wrong location or if it is missing. As an example, we will illustrate the labeling and cataloging of a small manual.

B. ORGANIZING AND MANAGING A TOOLROOM

An individualized instructional program can only be successful if the materials and tools a learner needs are readily available at all times. Just as the instructional materials in the LRC must always be in place and properly labeled, so must all the tools, materials, supplies and other needed items be labeled, cataloged, stored and easily inventoried. The general location for all of these functions can be termed the toolroom. The following resources discuss the toolroom and its management. If these are available they would prove useful to you.

> Installing and Operating An Individualized Instruction Program. Vocational Curriculum Center, Georgia State Department of Education. Pages 19 thru 25, especially items 1, 2, 3, 4, 6, 7, 8, 11, 12, 14.
>
> Manage the Vocational Laboratory, Module E-9. The Center for Vocational Education, Columbus, Ohio.
> Pages 8 thru 11, 24 thru 30, 34 thru 37.

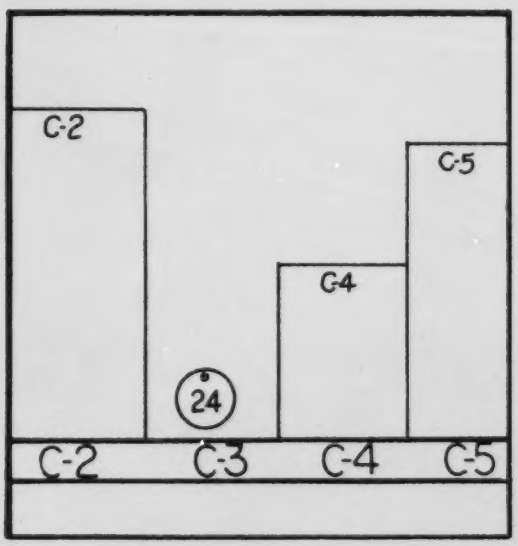
Toolroom will be used to denote an area where the following functions take place:



1. Storage and check out of tools and special equipment
2. Storage, inventory, and distribution of spare parts
3. Learning kits and special set-up kits, storage, check out, and maintenance
4. Storage and check out of shop manuals to be used in the laboratory
5. Storage and check out of training components used in instruction
6. Inventory and maintenance of all tools and special equipment in toolroom
7. Inventory of all manuals; ordering, cataloging, and filing of all new manuals and manufacturer's information

The main purpose of the toolroom is to keep track of the tools. There is nothing more frustrating to students than not having a tool when it is needed. Their frustrations will eventually lead them to the instructor who must stop whatever he or she is doing to try to locate what the student needs. If this is not done, the instructor may find an idle, frustrated and unmotivated student on his or her hands. In order for any program to operate efficiently, whatever students need should be readily accessible to them when needed. If the same tools are needed by more students than you have tools, you have an excellent justification for the purchase of additional ones. In some cases it is not the lack of tools which hinders their use, but it is their unavailability because they have not been returned to their proper storage area. A check out system will eliminate many problems of this nature. Such a system will be described later in detail.

The same reasoning which applies to tools also applies to learning kits, special set-ups, training components and shop manuals. Just as tools should be readily accessible, so should all of these items be there when needed by the student. The efficiency of instruction will be increased because of saving of time, of both instructor and student. These savings will result in faster completion times for the student and more effective use of the instructor's time in providing help in more important areas than hunting tools and supplies.



Inventory of tools, equipment, and other needed items must be an integral part of a system for organizing and operating an efficient toolroom. The kind of inventory needed is one which permits a person to know by looking if something is missing and if so where it is. This function again points out the need for an effective check-out system. It also dictates the necessity of a marking and labeling system such that each item is marked and its location labeled with the same designator as the item.

In addition to the visual inventory needed, a permanent inventory file should be established. Important information about each item should be recorded and updated as tools and equipment are updated, repaired, maintained or replaced. A maintenance schedule should be incorporated with the inventory system to prevent failure of tools and equipment when in use.

A last argument for the kind of toolroom operation that has been described is that industry, for various reasons, has been for some time moving toward the central toolroom concept. In times past it has been something of a game for employees to find an excuse to go to the toolroom, or stockroom, to kill time and socialize with other employees playing the same game. Management recognized the game being played and in many instances took steps to eliminate the problem by removing the opportunity to engage in the time wasting activity. By providing a well-trained and competent worker to tend to the tools and supplies, there is no opportunity for "hiding" in the toolroom. By having an attendant the other employees are relieved of the same problems and temptations of an unorganized and open toolroom. The operation of the toolroom in a training program should duplicate as closely as possible the operation of the same kind of a facility in industry. By providing this we provide our students with a setting which is similar to the one which they will find when they go on the job.

Contents of the Toolroom: We have already discussed briefly the contents of the toolroom. Now we will detail these contents.

1-Tools
2-Equipment
3-Parts/Materials
4-Learning Kits
5-Special Set ups
6-Shop Manuals
7-Training Components

The list shown at the left are categories which we will discuss in detail. You may or may not have items in your shop that fall into these categories. You may need to list other groups which we have not put down. The reason for grouping them is that some logical method of placing items in the toolroom is needed. By categorizing all of the items to be included in the toolroom, we form logical groupings to be used as toolroom sections. There will be exceptions where secure storage is needed for only a few of each group or the size of the tool dictates a special place in the room. When this occurs a notation should be made on the inventory card so that the item can be located easily.

1. In electronic occupations it is more convenient to group tools and equipment under the purposes they perform. This decision will have to be made by each individual instructor after considering the situation. Consider the groupings which are listed in the spaces below , remembering that certain items have more than one possible and logical placement. Items which belong in Group 1 or 2 could also be placed in Group A, B, or C.

GROUP 1

TEST EQUIPMENT

GROUP 2

REPAIR EQUIPMENT

GROUP A

METERS

GROUPS B

GENERATORS

GROUP C

HYBRID TEST EQUIPMENT

2. Equipment may not be self-contained in that it requires certain other parts and accessories to be utilized. This necessitates some means of grouping and storing all of the needed items together so that they can be checked out and in easily and inventoried quickly. Because the parts may be separated, some notation should be made on the main apparatus or on its storage level that another kit should be checked out with it.

3. Parts and materials may be a small part of your toolroom inventory. On the other hand, they may comprise a majority of the items stored. In either case they present a special problem in that they are consumed and must be carefully inventoried for reordering. A special section should be designated for such materials and approved industrial methods should be adopted for inventory control and reordering. Inventory control will be discussed a little later. Reordering procedures will probably be dictated by local regulations.

4. Learning kits are collections of components from commercial vendors or prepared by the instructor to provide simulated experiences for students while learning the principles of a task. They usually come in a self-contained package and should be easy to store and mark. The only problem area might be keeping inventory of the components checked in or out. To facilitate this a parts list should be fastened in the kit and also be placed on the inventory card.

5. In a vocational program there will be times when a special collection of items is needed by the student to use in completing a task. An example might be an assortment of resistors to be used by students in practicing reading the color-code and numbering systems. Each of these set-ups should be in its own storage unit and marked for easy access.

6. Training Components are similar to special set-ups but different in that they are usually larger and are a unified system such as a working radio. Along with everything else thus far mentioned each component should have its own specific place and mark or tag to correspond to its location.

There may be other items which you will want to store and you should do so especially if it will increase the efficiency of your program. In programs such as radio/tv, there is a greater number of parts than is found in most programs. Some of these, such as semiconductors, will require special attention to inventory and control or you may find materials giving out at critical times. Remember that you do not have the usual time to order for a group before each quarter. Now you will have students working in each area simultaneously. You must have an inventory system which keeps a record of materials continuously.

Toolroom Attendant: In the organization and management of the toolroom, the toolroom attendant becomes a very important individual. If it were possible they would be closely akin to a teacher aide. Since this luxury is not usually available to vocational programs, most toolrooms are attended by students on a rotating

basis. You should keep in mind, however, that the toolroom attendant is a legitimate occupation in itself. In fact, in the light which we will portray them, there are several different occupational titles for which they will assume certain duties.

First, let's emphasize that no matter how the toolroom attendants operate, full-time or part-time, their activities while in the position should be planned educational experiences. In order to help insure this, we will provide a task analysis for this position which may help you insure that learning has taken place. This listing, found on the following page, is somewhat general in nature and should be revised for each situation by being more specific in the tasks and writing objectives to go with them.

Task Listing for Toolroom Attendant

Major Blocks: Storage and Retrieval
Inventory and Order
Maintenance

Storage and Retrieval - (S & R)

1. Replacing tools, materials, supplies and other toolroom items in their correct locations.
2. Operating a designated check out system.
3. Naming tools, materials, supplies and other toolroom items using correct and accepted nomenclature.
4. Recognizing all toolroom items when called by their correct or trade accepted names.
5. Securing tools and toolroom as specified and according to the schedule dictated by the institution.

Inventory and Order - (I & O)

1. Marking and labeling toolroom items, storage positions and shop equipment in the laboratory.
2. Inventorying the toolroom through visual inspection.
3. Operating a formal inventory system.
4. Reading and using parts catalogues.
5. Requisitioning parts, supplies and tools.
6. Processing job tickets and time cards.

Maintenance - (M)

1. Cleaning and lubricating tools and equipment.
2. Repairing learning kits, set-ups, and training components.
3. Maintaining service records.
4. Cleaning toolroom and storage area.
5. Monitoring preventive maintenance program for shop equipment.

The extent to which the toolroom attendant will be an asset to you will depend on how you set up the responsibilities. Every task listed for the attendant must be performed by someone. If you do not train someone, student or aide, to do these things, you must do them yourself. This will either take time from instruction or add time to the end of your day.

LAYING OUT A TOOLROOM

It is always a good idea to use a systematic approach in any task that requires planning. One of the things you will need to do in adopting the Electronics/Radio/TV program is either to plan the layout of a new toolroom or to modify your present one. When planning always make a completely objective view of your needs. Do not plan on what you now have, but on what you need to have for the best possible program. Later you can modify this plan when considered in light of the realities of the situation. Again, you should not give up your best plan, but keep it as a planning document for the future. Following is a step-by-step procedure which can be used to estimate your needs and lay out your toolroom.

Step 1: Deciding on the functions of the toolroom and the space required.

A. Storage is probably the single most space consuming function to be accomplished in the toolroom. Before you can plan for storage, you must inventory the items you are to store. While performing this inventory it would be a good idea to label and catalog each item.

Inventory and Marking: In order to accomplish this task systematically, a step-by-step procedure which has been used successfully is detailed here.

A. Decide on the groups of tools that you will use as a basis for your storage and inventory. There will be categories for materials and supplies and for any other items to be stored such as resistors, capacitors, metal, hardware, learning kits, etc.

B. Divide each of these groups into types of tools.

C. Next, you need to determine a numbering system that will be used to mark your tools and help you inventory and keep accurate records. As you mark the tools write the number down so that you do not assign more than one number to a tool. As an example, suppose you have 4 pairs of 6 inch long nose pliers. The numbers assigned might be:

HT-001-01
HT-001-02
HT-001-03
HT-001-04

If they are identified some other way, such as trade name, record this information also:

HT-001-01-Craftsman
HT-001-02-Craftsman with red handles
HT-001-03-Snap-on
HT-001-04-Green handles, Japan

The information recorded will go on inventory cards, so put whatever is pertinent and descriptive. If the tool is damaged, record it here also.

Having a listing and inventory card system may seem like extra work to you; however, there are two ways you will need to find tools. First, you may need to look up a number. This can be done by the list. Second, you may need to find information by name. This will be found by the inventory card system.

There are two types of inventory cards needed in the toolroom. One type of card is for consumable supplies. The other is for tools and/or equipment. We will discuss each type independently and make some recommendations for each. In both cases a card 4" X 6" or larger is being referred to.

Tool and Equipment Inventory

1. Hand Tools - Only one card for each type of hand tool is needed. In addition to the information found on the inventory list made, the original cost and purchase date should be added. When replacing broken or worn-out tools this information may help you decide on the brand of tool which is the best value. A part of a sample hand tool card is shown below.

PLIERS, LONGNOSE, 6 INCH		
HT-001-01 Craftsman	4/7/78	3.00
HT-001-02 Craftsman, w/red handles	4/21/78	3.50
HT-001-03 Snap-on	5/10/78	3.25
HT-001-04, Japan green handles	6/1/78	Surplus

More than one line can be used for information if it is needed. Some space should be left to record information as tools are damaged or handles replaced.

2. Tool kits or sets - One card should be made for each set. The inventory number of the set and contents should be recorded just as if each part were a separate tool. A sample is shown below. Adequate space is left on the back of the card for remarks relating to part breakage and replacement.

SOCKET SET, 3/8" square drive, standard, 12 pts.
Craftsman, 4/1/78, 40.00
HTS-001-01A* Flex T-handle
HTS-001-01B Cross Bar
HTS-001-01C 7/16" Socket
HTS-001-01D 1/2" Socket
HTS-001-01E 9/16" Socket
HTS-001-01F 5/32" Socket

*An alternate notation of a piece of a set might be HTS-001-01-1.

Tool sets, tools or equipment which require maintenance either in-house or by outside companies should have a record of this work. On the back of the inventory card this should be recorded in a manner similar to that shown below.

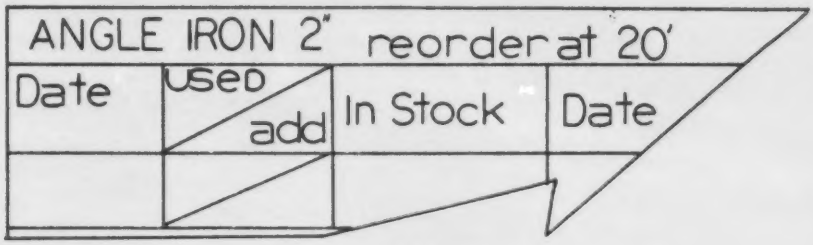
Date	Service	By Whom	Cost
7/2/78	Replaced PT-T_2	WHS	8.90
7/7/78	Replaced Q_1 diode	WHS	1.50

Special set-ups, learning kits or training components should be handled in the same way. Exact specifications should be recorded for components in any of these so that replacement of parts can be accomplished easily.

3. Equipment - More than one card may be needed for some equipment and kits. Keep the cards together if there is more than one and mark the title of each card the same with a notation such as "Card 2 of 3" or whatever is appropriate to be added. If equipment requires periodic servicing a notation should be on a calendar regarding the time for maintenance. A calendar just for this purpose should be kept. Whenever service is performed, it should be recorded on the inventory card and the next service date entered on the calendar.

Supplies, Parts and Materials Inventory Card

An inventory card for each type of supply or part should be kept. It should show the amount or number in stock, when the last was ordered and a notation every time the stock is reduced. It should also have a note to tell at what level of inventory new stock should be ordered. The sample below includes all of this information.



Information on the back of the card can be used to reflect suppliers, cost of last order or any other information needed to reorder.

Once you have completed your inventory, you can estimate the amount and kind of storage you will need. There are three basic storage methods used in most toolrooms: Silhouette boards, shelves and cabinets. For materials and supplies, other configurations will be needed depending on the shape, weight and quantity of the items. First, determine the space needed for each item to be in the toolroom, then plan for space for the toolroom attendant to work.

Example: The following space requirements have been determined by an instructor.

1. Tools
   Hand Tools; 2 - 4' X 8' boards
2. Equipment — 30 ft. shelving
3. Parts/Materials — 1 1/2' high X 3' wide for 24 drawers
   3' wide X 7' high for 60 parts bins
   8' shelving
4. Learning Kits — 17' shelving
   6' shelving - 6" high
5. Special Set-Ups — 16' shelving
6. Shop Manuals — 12' Shelving

7.	Training Components	4' - 24" shelving 8' - 36" shelving for heavy components
8.	Future needs	4' X 6' board 24' shelving

A working area of about 4' X 3' is needed for tool maintenance. A vise and bench grinder should be mounted on this area at either end.

Other possible needs: If you plan to have your attendant order parts and materials on a regular basis, a telephone area and space for catalogs should be provided. You may even wish to include a typewriter and adding machine. If all of these are to be used, a desk may be appropriate.

We will now add these areas to our example and see what we come up with.

9.	Inventory	Sit down 2' X 3' space with knee room
10.	Maintenance	Stand up 6' X 3' bench with recessed area under
11.	Parts Ordering	Sit down 4' X 3' space with knee room

Step 2: The second step in our planning phase will be to total up our needed space so we can make some sketches of what the storage units will look like. In the example we will not plan any storage over 7' high. You may want to go higher if your floor space is limited. If that is the case, you will need a very sturdy and easily moveable ladder or rolling stairs.

Example:

A. Total area of silhouette boards needed:

Tools - 2 - 4' X 8'	= 64 sq. ft.
Future- 1 - 4' X 6'	= 24 sq. ft.
	88 sq. ft.

In this example we will be sketching 8' wide modules. From the figures above it can be seen that three 4' X 8' boards could be used.

B. Total feet of 12" shelving needed:

Equipment	30'
Parts	8'
Kits	17'
Set-Ups	16'
Future	24'
	104' of 12" shelving

Total feet of 24" shelving:

Training Components	12'
	12' of 24" shelving

Total feet of 36" shelving (heavy):
Training Components 8'
8' of 36" shelving

C. Bench space (desk):

Inventory	2' X 3' sit down
Parts Ordering	4' X 3' sit down
	6' X 3' sit down
Maintenance	4' X 3' stand-up

D. Miscellaneous:

Parts/Materials	1 1/2' X 3' on wall
	3' X 7' wall or standing

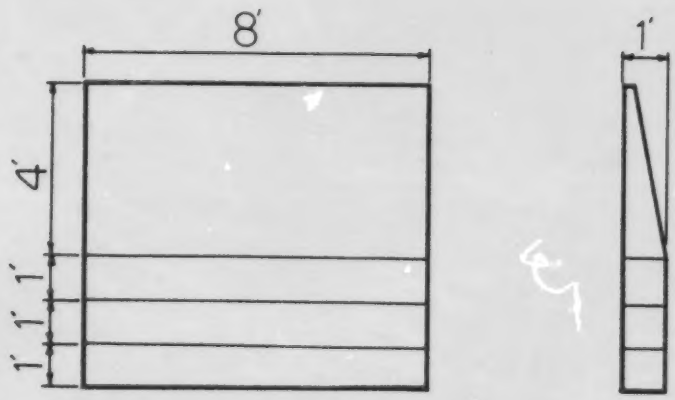
Summary of needed space:
3 4' X 8' tool boards
101' of 12" shelving
12' of 24" shelving
8' of 36" shelving
1 1/2' X 1 1/3' of wall space
3' X 7' of wall or standing space

6' X 3' sit down work area
4' X 3' stand-up work area

Step 3: Sketches are now needed of what the storage units may look like.

Example:

Tool room Unit 1



Storage provided:
1 4' X 8' Board
24' 12" shelving

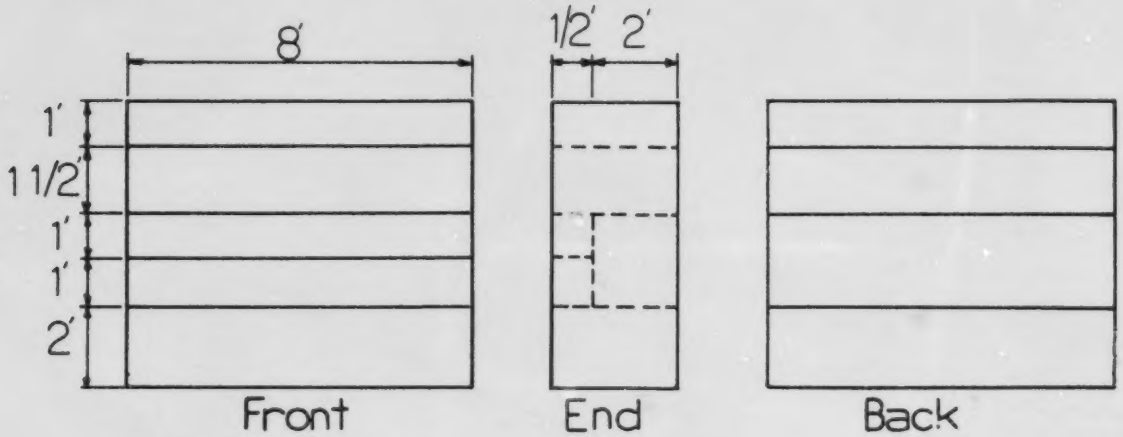
Toolroom Unit 2 (same as Unit 1)

Storage provided:
1 4' X 8' Board
24 12" Shelving

Toolroom Unit 3 (same as Unit 1)

Storage provided:
1 4' X 8' Board
24' 12" Shelving

Toolroom Unit 4
(access from both sides)



Storage provided:

40'	12" Shelving (18" counted as 12")
16'	24" Shelving
8'	36" Shelves

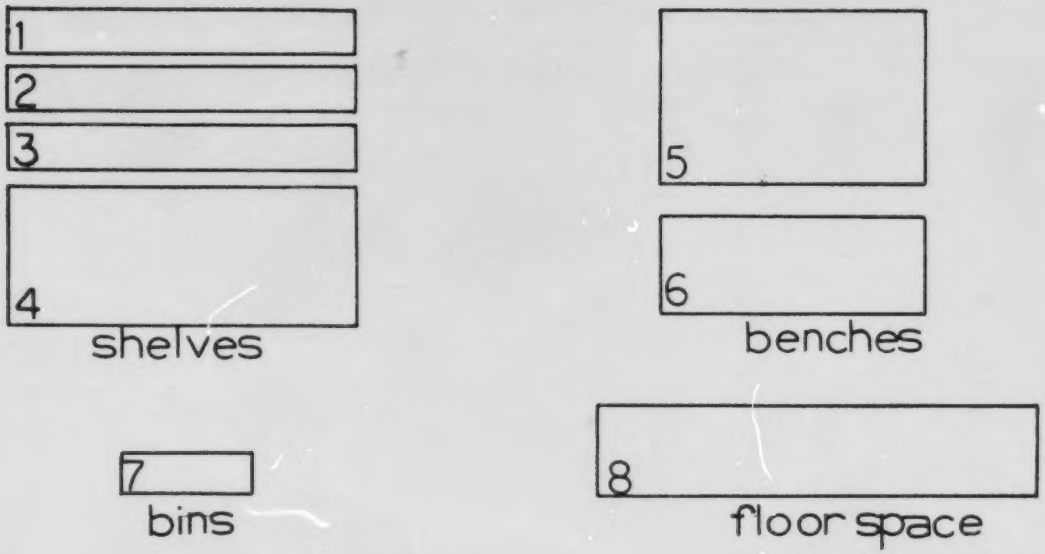
With these units more than enough shelf space has been provided. The 3 silhouette boards needed have also been taken care of.

The needed wall space, work bench and desk areas will be taken care of in the next step.

Step 4: The proposed modules will now be sketched to scale as they will look from a top view. Then with a grid they can be arranged and rearranged until a suitable floor plan is found. If necessary some of the modules can be divided to fit existing facility arrangements.

Example

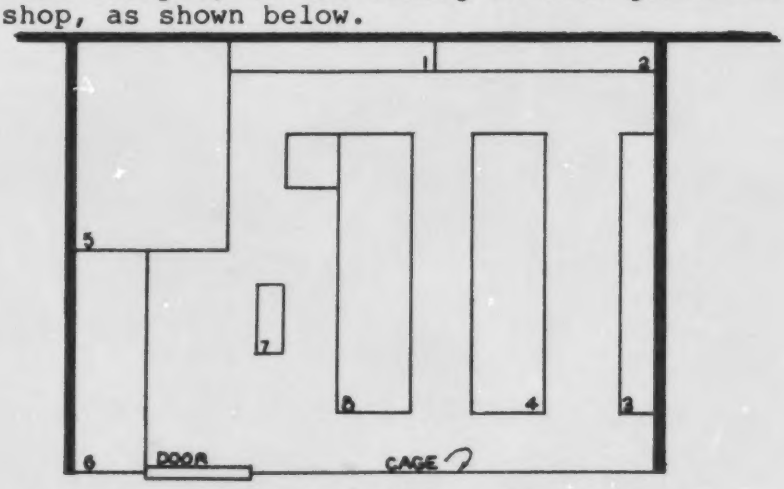
Toolroom Units



Be sure to mark pertinent information on the top views. This includes which side(s) are open, if receptacles are needed, if the unit needs to be on a wall, or anything else which might affect its position. If the space is available, leave three feet between units.

Step 5: Using the outlines in Step 4, find a suitable layout. With a grid pattern of the shop, find a suitable location of the modules. Remember that they must be arranged together so that they can be enclosed with only one access point.

In the example, we are making an arrangement using the corner of a shop, as shown below.



Total Area 12' X 16' - 192 sq. feet

Many other arrangements are possible with the units as they are. If you go higher or make the units in 4' widths or vary in some other way, still more variations can be made.

Step 6: In this step you need to make any changes mentioned above until you come out with a plan that will work. You may need to go back as far as redesigning your storage units. Always remember to design according to your needs first, and then make changes as you must to fit the realities of the situation.

C. REVIEWING PROGRAM MATERIALS

The following steps should be followed in receiving and reviewing materials. These instructions are taken from pages 13-17 of Installing and Operating an Individualized Program.

Receive audio visual materials

Along with the AV slides and tapes, you should receive what is known as a "Summary Sheet." This "Summary Sheet" will serve as a "check-in" list that you can use to verify that all non-commercial, state-developed audiovisuals have been received. The slides will be in boxes with each presentation separated by a colored slide mount. The first slide in each presentation has the presentation's I.D. number on it. Along with the slides, your AV shipment should include the cassette narration tapes and a copy of the script. If, per chance, any AV materials are missing, you should immediately send a post card to:

Vocational Curriculum Center
3952 Shirley Drive, S.W.
Atlanta, Georgia 30336
(404) 656-2614

Review and file AV's

First, put all the slides in proper position and sequence in slide trays. Next, view and listen to all the AV presentations while following the script. Verify that there are no mistakes, missing slides, etc. When you have completed putting the slides in trays and reviewing the AV, you should number the slides to aid you in replacing them in proper position should the slides be dropped or spilled. Another suggestion is to use a felt marker and draw a diagonal line across the top of the slides when they are in proper position. In this way, if slides are dropped, it is obvious in which position they belong. You should also make a duplicate copy of all cassete tapes and keep the originals in a safe place. Finally, place slides and tapes in their appropriate storage areas.

Review and file written I.I. materials

When the "software" (written material) arrives, you need to determine the filing method you will use, check the materials in against a "Summary Sheet" check-in list and then file all but two copies of the student and Instructor "software" (training materials). The student software, i.e. Unit Sheets, Information Sheets, Job Sheets, etc. may be filed in one of several ways.

* Total materials stapled as a book
* stapled together by units with Unit Sheet on top and the other unit elements following as appropriate,
* or broken down into separate sheets with Unit Sheets in one file and Job Sheets in another file, etc.

Whatever method you use, be sure to file materials in an "easy-to-retrieve" manner.

Preview all written materials received

Previewing accomplishes several important things.

*It familiarizes the instructor with the concepts, procedures, terminology and approaches used in the I.I. course materials.
*It affords the instructor the opportunity to compile the required list of needed text books, reference manuals and supplies required for the I.I. program.
*It allows a chance to evaluate if there is equipment that must be obtained in order to use the program as it is, or if slight modifications or adaptations need to be made in the materials in order to use them at your school. Caution! If any modifications are considered (by agreement of coordinator and instructor), then these modifications should be accomplished in close coordination with a curriculum and media specialist. Ideally, you will use the program as close to the original as possible! By all means, do not make changes without first trying the materials as they are.

D. STARTING STUDENTS

Many times you will be faced with starting both new and advanced students. If your timing is perfect, you may only have to deal with new students. In the case of new students, the best way to start them is in small groups several days apart. As an example, suppose you have fifteen new students who are to enter your program. Since all new students are to start with the same unit and require individual conferences, it is best to have them not only on different days, but at different times. You might divide the fifteen into three groups of five and assign them a day and hour to come. The schedule below illustrates how this might be accomplished.

Period	mon	tue	wed	thur
1	1*			6
2	2			7
3	3			8
4	4			9
5	5			10

*students

If you want more than one hour per student for orientation and conference, assign them so this time will be available. In this case you might establish a schedule as shown in the next illustration.

1	1	4	7	10
2				
3	2	5	8	11
4				
5	3	6	9	12
6				
7				

If all of the students must register on the same day because of school policy, let them register together and make time assignments as to when they should return. If you ask, some students may volunteer for delayed entry.

If you have some students who are returning after a period of layoff or a few advanced students use them as toolroom attendants until they receive orientation and are placed in the correct place in the program. They would have knowledge of the equipment and be able to assist you until the new students can take their turns.

After a few days, the students will spread out due to their varying abilities and learning speeds. Once the program is in operation you should never again have a large number of new students entering. This is due to the fact that they will be completing their occupational objectives at different times and new students will be taking their places immediately.

Since this program is individualized, students have the opportunity to progress on their own abilities. But before they can progress on their own, they must have knowledge of several areas. They must be aware of school policies and procedures, of the operating procedures of the program they are in, the location of what they will need and how the program operates. Many of these can be accomplished through individualized methods such as audiovisuals and written instructions. The materials that come with the program include an audiovisual presentation to explain the operation and use of the instructional materials.

Another item which must be discussed and decided upon is the program objective for the student. Next, you must consider any prior training and where in the program is the best place for them to start. This program objective and plan for its accomplishment should be recorded and filed in the student's records. This and other items of an individual nature should be taken care of during a conference when the student arrives.

All of these procedures should be put into an orientation plan and prepared as an instructional unit.

E. HOW THE PROGRAM IS ORGANIZED

When correctly set-up, the Electronics/Radio/TV program should operate in the following manner.

After students enter and are given the proper orientation, they decide on the program objective which best suits their needs. Once this has been done, each student starts on the task assigned to him/her on the program.

The flow chart on the next page depicts the sequence of steps students might follow as they work through their tasks. Tasks may be primarily theory, primarily performance or a combination of both theory and performance. A majority of the unit sheets guide the students through reading/study assignments, audiovisuals and lab activities. Ideally, a task would be learned by the student's first learning the theory of the operation, next learning the procedures to be used, then practicing with instructor supervision, as needed, and finally being tested on performance. Where needed, more practice may be prescribed on live projects assigned to combine and reinforce skills. Live projects are also used to simulate actual occupational tasks.

F. PROBLEMS AND SOLUTIONS

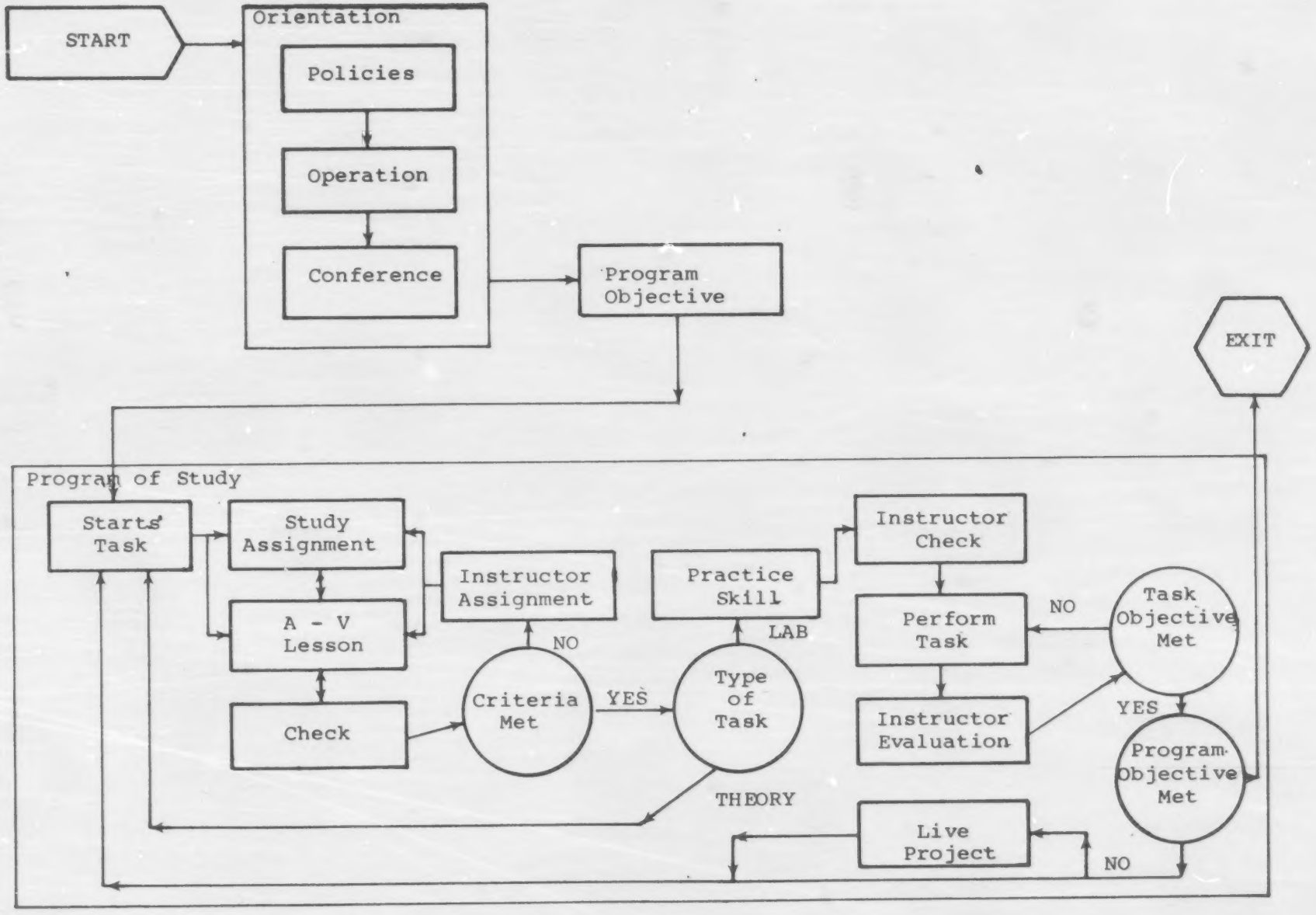
The student would continue to progress through the tasks on his/her program of work until the program objective had been completed. There are, of course, many problems encountered which hinder the program from operating properly. The most common problems encountered and some suggested solutions for these problems are found in:

Installing and Operating An Individualized Instruction Program, pages 43-59.

G. MANAGEMENT OF LIVE WORK

Live projects are essential to a complete Electronics/Radio/TV program; however, too much live work can also prevent a training program from operating. Some basic guidelines for live work should be established and these should be approved by your administration and then well publicized. Some of the most important points to remember are discussed below.

1. Live work should only be used to reinforce or add to a student's skills. This work does not constitute the training program, but is only another experience used to accomplish the objectives of the program.


START
Orientation
Policies
Operation
Conference
Program Objective
EXIT
Program of Study
Starts Task
Study Assignment
A - V Lesson
Check
Instructor Assignment
NO
Criteria Met
YES
Type of Task
THEORY
LAB
Practice Skill
Instructor Check
Perform Task
NO
Instructor Evaluation
Task Objective Met
YES
Program Objective Met
Live Project
NO

2. A student should not be forced to do projects which are not necessary to learning. Troubleshooting one or two television sets might be justifiable as needed for training. More than that number done by any one student would be excessive in most cases. Excessive repetition interferes with the progress of the student through the program of study.

3. A set of procedures and a work order form should be established. The work order form should contain statements that explain how the projects are to be done by the students and a release of the school and teacher from any liability should be signed before work is begun.

You should make sure that live projects enhance your training program and never hinder training that should be taking place.

4. Each project should be evaluated by the instructor and a record of the project and performance placed in the student's record.

H. STUDENT EVALUATION

Since there are well established criteria for the acceptability of television performance, it will be no problem to establish minimum standards of performance. A problem does arise when you begin to differentiate between levels of performance. To complete a task each student must meet the minimum standards. If you assign a value of "C" or 70 or some other arbitrary mark to minimum, then you must decide on what will constitute "B" or "A" or anything in between. In Installing and Operating An Individualized Instruction Program some suggestions concerning grading are given on pages 47 through 55. In the list below, some factors are given to consider when making your grading criteria.

1. The time required to reach the objective, that is how long it takes to learn how to do a task, may be a consideration in grading. Every effort should be made to encourage students to progress as fast as they can. By having the time as a grading factor, you may motivate the students.

2. The number of attempts at satisfying an objective would also contribute to a student's performance rating. You may want to grade a student higher if there is success on the first attempt rather than on subsequent tries.

3. Dependability is another trait which should be considered when evaluating student performance. Dependability includes attendance, punctuality, self-motivation and use of time. In view of recent research into the reasons workers are able to keep jobs, it has become apparent that skills are not as important in keeping jobs as are dependability and other personal habits.

4. Working habits and the quality of work done are important factors which need to be included in any evaluation. Good work habits are exhibited by a systematic and orderly approach to performing an assigned task. Good housekeeping is an example of good work habits.

Work quality includes conforming to standards which are expected by industry. Minimum standards are required, but above minimum standards deserve extra consideration.

On page 52 of Installing and Operating an Individualized Instruction Program an example of how certain factors used in evaluating students in an electronic program can be converted into a point system. You should consider this for your program in order to help you arrive at a performance grade.

EVALUATING TROUBLESHOOTING REPORT

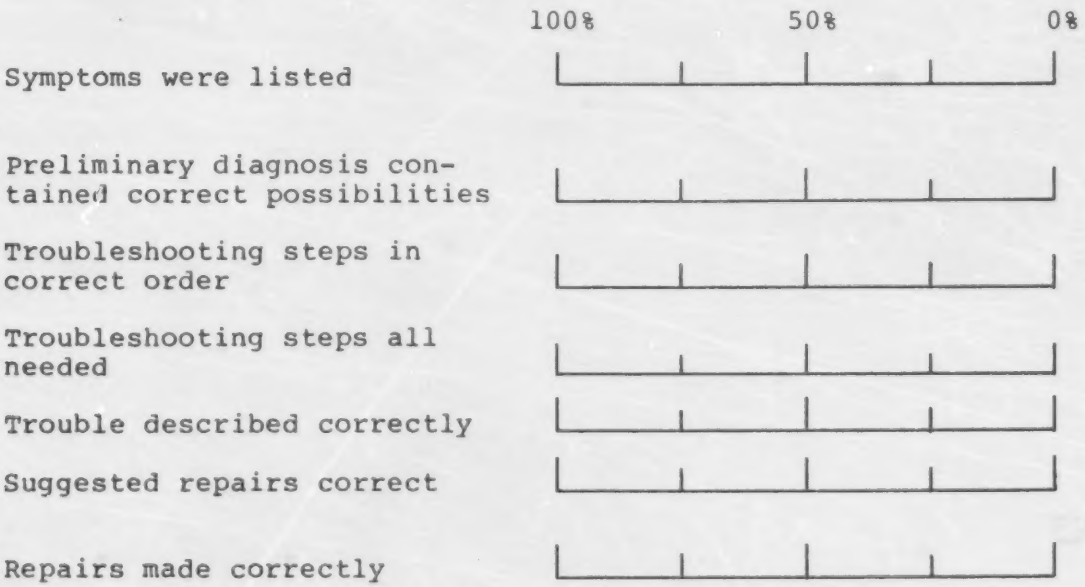
Every time a student troubleshoots a set you should evaluate both the results and procedures used. It is a good idea from both an educational viewpoint and utilization of your time to use advanced students in their final phases to troubleshoot each set. Then depending on the troubles and their complexity, you can assign the set to a beginning student who needs the particular trouble.

An accurate and up-to-date progress chart must be kept on each student in order to utilize live jobs to their fullest. This also will prevent your assigning too many of the same problem to a student.

The following procedure for using troubleshooting charts and evaluating progress are suggestions that can be modified to fit your situation. These should work whether or not you use a bugged set or live work.

1. Have an advanced student troubleshoot set and fill in troubleshooting report. In some cases you may have to help to make sure of the procedures used.

2. Carefully check the troubleshooting procedure using the following checklist.



3. Evaluate the advanced students and then correct the troubleshooting procedure to your satisfaction.

4. Use the correct chart to grade the beginning student.

ELECTRONICS/RADIO/TV

_____
(Student Name)

Troubleshooting Report - Unit ___

Receiver Make _____
Receiver Model No. _____
Starting: Date _____ Time _____ Ending: Date _____ Time _____
Symptoms _____

_____

_____

_____

Preliminary Diagnosis _____

_____

_____

_____

Troubleshooting Procedure:

TEST POINT	STAGE OR COMPONENT	TEST V(a-c)	V(d-c)	R	Waveform	RESULTS (tell if it is to specs)

ELECTRONICS/RADIO/TV

_____
(Student Name)

Troubleshooting Report - Unit _____

Components Tested

COMPONENT	TEST	IN OR OUT CIRCUIT		RESULTS	CONDITION	
		IN	OUT		GOOD	BAD

Describe trouble _____

_____

_____

_____

Describe suggested repairs (service and parts) _____

_____

_____

_____

Instructor's approval to do work _____ (Initials)

Operation of set after repair _____

_____

_____

Time required _____

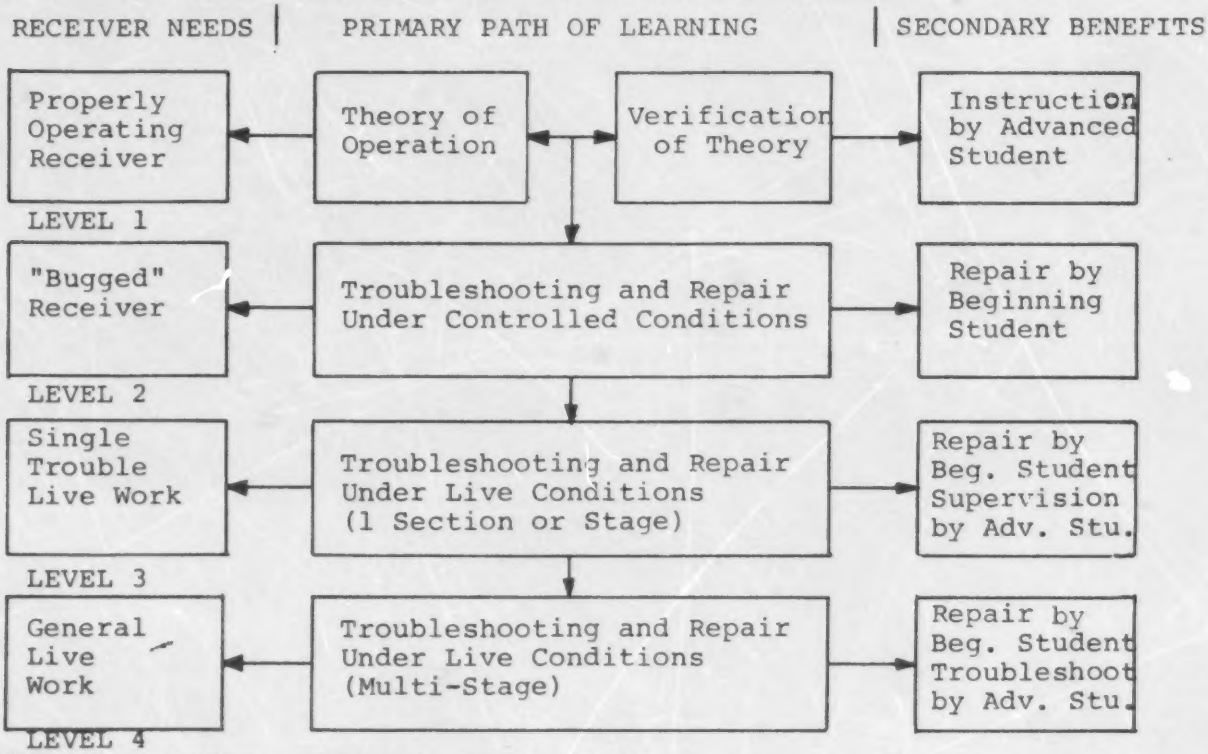
Instructor's approval of repairs _____ (Initials)

Scheduling needed jobs for use by students

During the course of this program and especially in the television servicing phase, you will need to provide some receivers which are operating properly and some receivers with defects in certain sections. Properly operating sets should always be available; sets with defects should come from two sources. First, you should have a lab set or trainer that can be used for this purpose. Second, you can plan correctly and use live sets as they come in. In order to make the system that is needed work, you must plan and organize efficiently and most importantly you must keep accurate records. These records must be kept up to date continuously or your system will fail.

The information you will need to have readily available is the point to which each student has progressed and what type of troubleshooting or repair practice each needs. This information should be available from two sources. First, a group progress chart should show exactly where a student is and give a general idea of what type of live work or practice is needed. Second, the individual records of each student should tell exactly what the student needs, how much more practice is needed, and all of the past performance of each student.

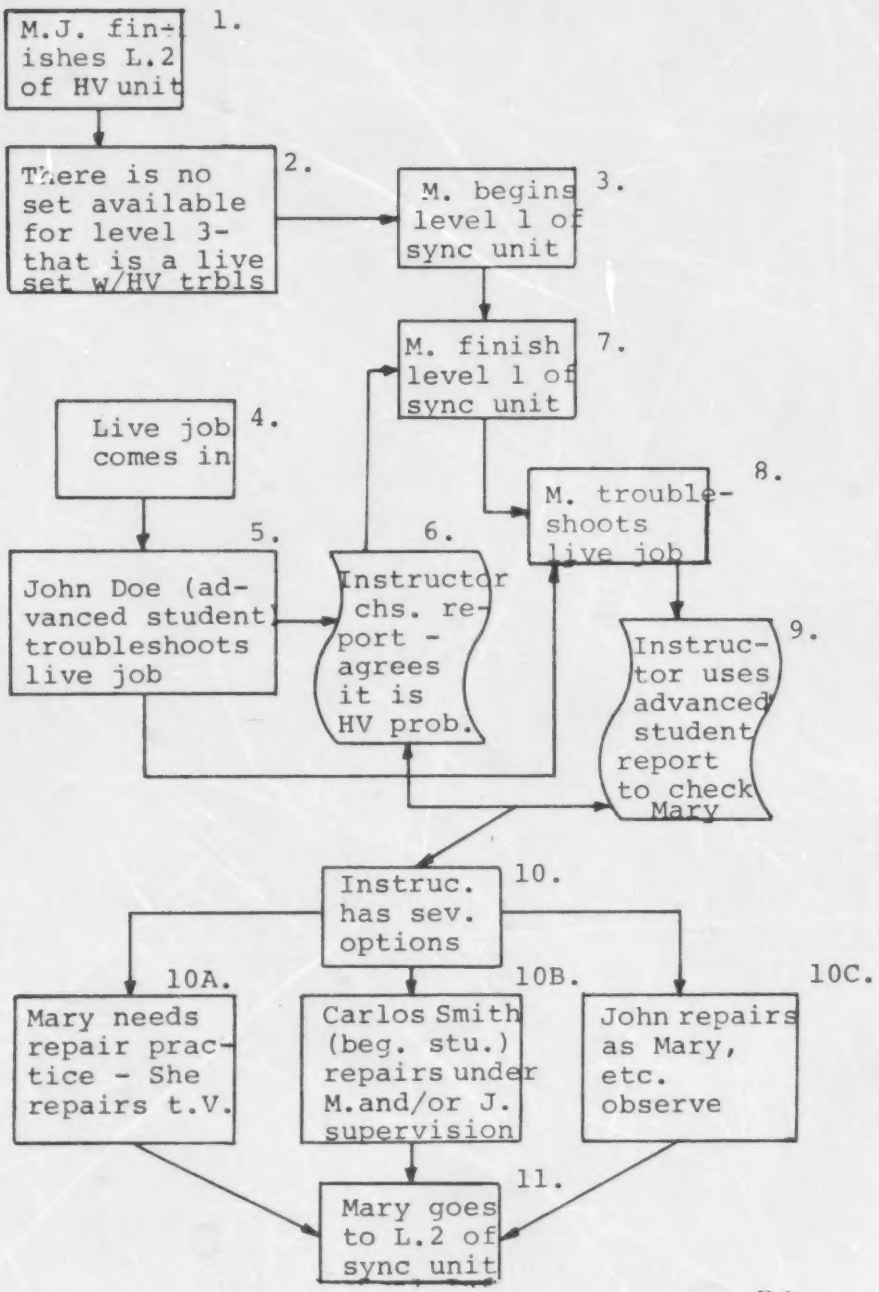
A general discussion of how to set up and use both group and individual progress records is found in another section of this manual. In this discussion we are interested in how to use these records to help you plan for student needs for specific types of jobs. The use of the system proposed is based on the manner in which the learning is designed in this program. Learning has been planned to take place in the following order.


RECEIVER NEEDS
PRIMARY PATH OF LEARNING
SECONDARY BENEFITS
Properly Operating Receiver
Theory of Operation
Verification of Theory
Instruction by Advanced Student
LEVEL 1
"Bugged" Receiver
Troubleshooting and Repair Under Controlled Conditions
Repair by Beginning Student
LEVEL 2
Single Trouble Live Work
Troubleshooting and Repair Under Live Conditions (1 Section or Stage)
Repair by Beg. Student Supervision by Adv. Stu.
LEVEL 3
General Live Work
Troubleshooting and Repair Under Live Conditions (Multi-Stage)
Repair by Beg. Student Troubleshoot by Adv. Stu.
LEVEL 4

The flow chart on the previous page shows the general design of each unit. At each step in the procedure you will be able to integrate several students into the learning process. Also notice that a certain "type" of receiver condition is needed to keep the system operating. One characteristic of the system that helps to keep it working is that receivers needed for levels 3 and 4 do not have to be available at the exact time level 2 learning is completed.

To see how an operating system works let's look at an example.

Example 1.


M.J. finishes L.2 of HV unit
1.
There is no set available for level 3- that is a live set w/HV trbls
2.
M. begins level 1 of sync unit
3.
M. finish level 1 of sync unit
7.
Live job comes in
4.
M. trouble-shoots live job
8.
John Doe (advanced student) troubleshoots live job
5.
6.
Instructor chs. report - agrees it is HV prob.
Instructor uses advanced student report to check Mary
9.
Instruc. has sev. options
10.
10A.
10B.
10C.
Mary needs repair practice - She repairs t.V.
Carlos Smith (beg. stu.) repairs under M.and/or J. supervision
John repairs as Mary, etc. observe
Mary goes to L.2 of sync unit
11.

In order to accomplish this type of procedure smoothly and efficiently, an instructor must know where each student is and what he/she needs. In the example above, the needed information and its source are described.

Step 1 - The group progress chart must be marked that Mary stopped after completing Level 2 of HV unit.

Step 5 - The group progress chart shows that John Doe needs general troubleshooting practice.

Step 6 - The troubleshooting report by John shows HV problem. Group chart shows Mary needs HV practice. (If more than one student is at the same level, the instructor can check individual folders to see if the problem available has been solved by either student.)

Step 9 - Instructor uses John's chart to check Mary's report.

Step 10 - Instructor uses group progress chart to select students needing task. Instructor uses individual folders to select student.

Certainly this is a simplified explanation, but it can provide you with the general idea of how to control one of the biggest problems T & I instructors have. The problem is making sure that each student can do the jobs he/she needs to do and, at the same time, making sure that no student is over trained on any one type of job.

From the example you can see that three types of information are needed.

1. Group progress chart
2. Individual progress chart and records
3. Troubleshooting reports

Each of these is discussed in other sections of this manual.

ELECTRONICS/RADIO/TV

_____
(Student's Name)

LIVE WORK ASSIGNMENT SHEET

Unit Number _____
Purpose of Assignment _____

_____

_____

Type of receiver _____

Manufacturer and Model Number _____

Defect Symptoms _____

_____

_____

_____

Symptoms Checked by 1. _____

2. _____

(Instructor's Initials) _____

Results of Testing (attach troubleshooting report)

_____

_____

_____

Suggested Service

_____

_____

_____

_____

Instructor's Approval _____ (Initials)

Results of Service _____

_____

_____

_____

_____

I. STUDENT RECORDS

There are many records that an instructor is required to keep for administrative purposes. In this section we will discuss those records which pertain to students. These records are ones which are necessary if an efficient educational program is to be run. Before discussing what should be kept, it may be helpful to establish justification for keeping student records at all.

Certainly you must keep two kinds of information on students: grades and attendance. These are required in all educational situations and will probably always be required. Many teachers have been able to use one small record book and keep up with both of these items. With the increased use of individualized instruction and continuous change in student population, a need for individual records has become increasingly apparent.

Another reason for keeping more accurate records is found in the increased pressure from the public section to justify grades with documentation of performance. For these reasons a system is needed which provides for individual records of a more detailed nature than the traditional "class record book." Each student needs to be supplied with an individual file. As students leave and enter the program, these files can be moved from current to pending status and back again if a student re-enters.

What are the minimum records that need to be kept?

PERSONAL DATA
ATTENDANCE
GRADES
PROGRESS
TESTS
DISCIPLINARY
FOLLOW-UP

Whether an institution keeps a master record file or not, each instructor should maintain his or her own record system containing the above information.

Since most all institutions have a set procedure to keep attendance and personal data, we will leave these items to you.

Progress and grades are two items of extreme importance and can be easily kept together. At this point we will not discuss how you assign grades nor what methods you may use in evaluating student progress. We are concerned at this time only with the recording of these items. Since you are using an individualized instructional program developed by the State of Georgia, there is a progress chart with the program. This may fit your needs or you may decide that you need another form with more or different information.

The following information should be kept on any complete individual progress chart.

1. Student name
2. Student I.D. number
3. Unit titles and numbers for task to be worked on
4. Beginning date for unit
5. Ending date for unit
6. Written grade
7. Performance grade
8. Daily/Attitude/Work habit grade
9. Time spent on task
10. Unit grade
11. Course or major block grade

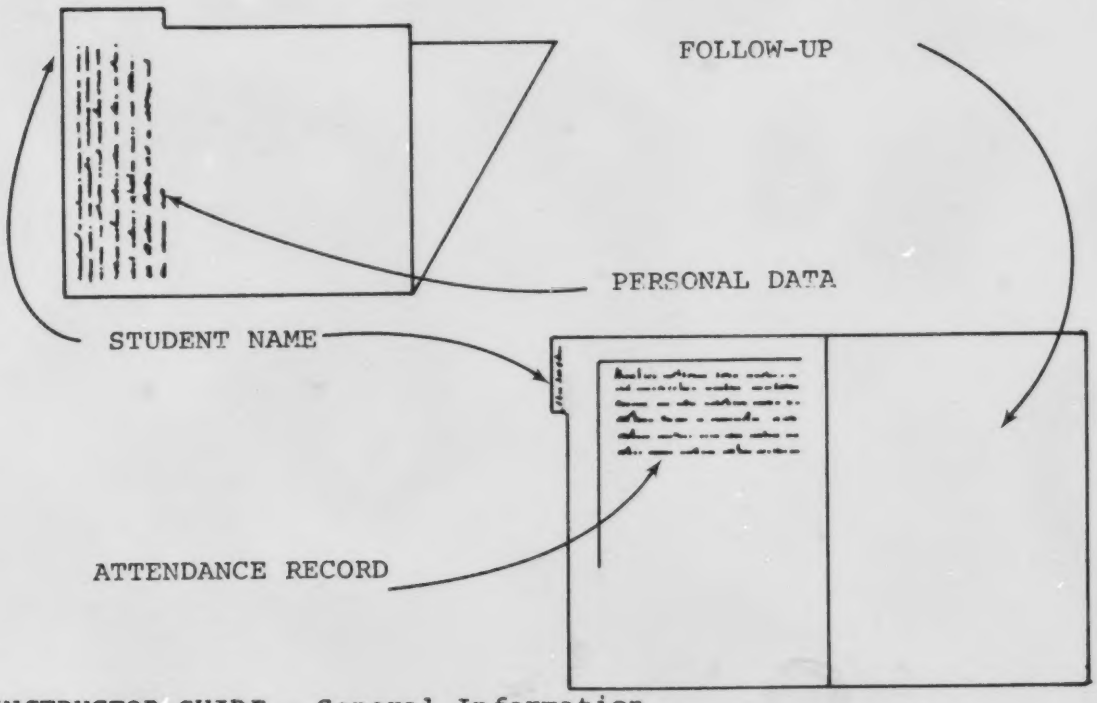
A portion of a progress report containing these items is shown on the following page:

NAME _____

NUMBER _____

UNIT NO.	START	END	TIME	GRADES				COMMENT
				WR	LAB	DAILY	FINAL	
OXYACETYLENE								
A-1								
A-2								
A-3								
A-4								
A-5								

Each student should have an individual folder in which the progress charts are contained. The documentation for grades in the form of tests and evaluation should be filed in the correct sequence behind this report. Since personal data and attendance records will be the same for every program, it is convenient to have this information printed on the folders.



Follow up data is also kept in the folder. Since this information is similar for all programs, it could also be printed either on the inside or back of the folder. The following information should be included. (New federal laws are beginning to require follow-up data when federal funds are involved in the training program).

1. Student's immediate employment after leaving the program.

2. Six month follow-up:

   A. Student success
   B. Employer satisfaction
   C. Assessment of value of program
   D. Additional tasks needed for job
   E. Included tasks not needed on job

3. One year follow-up

Your institution or new regulations may require more information or a longer period of follow-up. You must take this into account when designing your follow-up system.

We have discussed briefly a few of the important items that belong in your student record files.

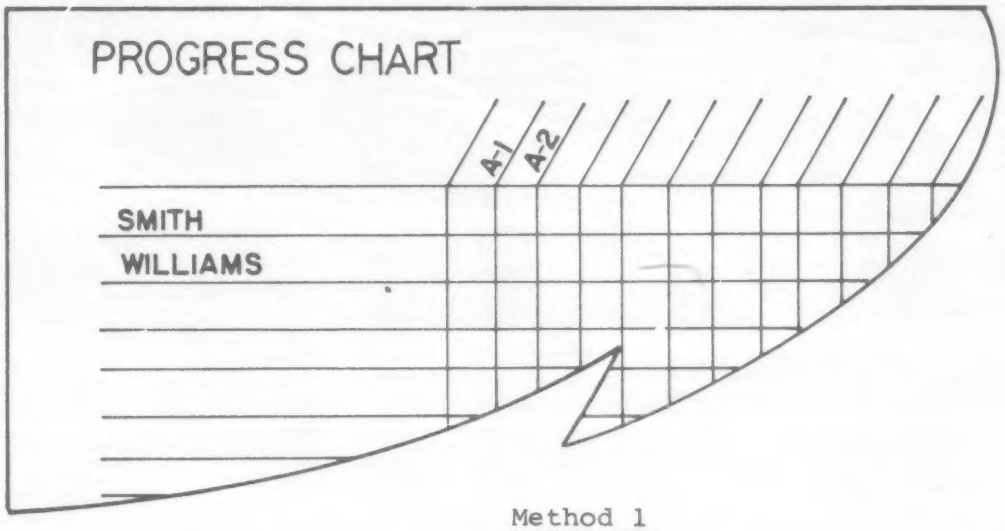
Designing your record keeping forms may be the easiest part of keeping records. The hardest part is collecting information, allotting time to complete the forms and filling in the data. The best time to record the information is when you get it. Since it is not convenient to carry all of your student folders with you (although some instructors use a portable filing cabinet to do this), you may carry a small notebook or stack of cards with you to collect the information. Later you can transfer this to your permanent files. Whatever you do, record your findings each day. Many instructors set aside a particular time each day for these activities.

J. GROUP PROGRESS CHARTS

Although you need an individual folder for each student, there are good reasons for having a group progress chart. One of the advantages to you is that it provides you with a quick determination of where all of your students are in the program and how rapidly each is advancing. If you fill in the chart correctly, you can use the information on it for managing student flow and lab utilization. You can also use it to determine which student is ready for live work coming into the lab and for estimating when you may have an opening for new students.

On the following pages are examples of ways to mark group charts and how the charts might look when filled in. One method of marking we will not be able to show here is the use of color. Many additional coding schemes are possible using color if you will put some thought to it.

Almost all wall progress charts are composed of blocks with spaces for task names across the top and student names going down the side. In lieu of printing actual task name many times, they are coded using a preassigned number.

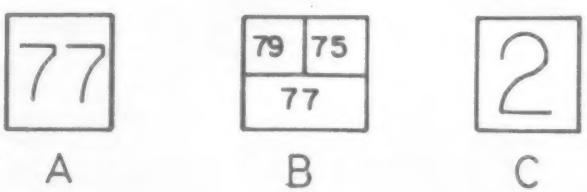


Method 1

The simplest method to use is merely to check the student off when he completes a job. The only information to be gained by this method is where the student is at any time. For some instructors this is all they want the group chart for. To these instructors it is important that the student not be compared to the group in any way. They think that grades or other information such as time spent on a job should be strictly confidential.

Method 2

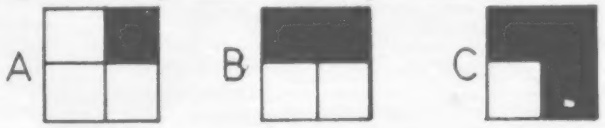
A similar method to number 1, but using different information, is to place grades in a square when the unit is completed.



In the same way that many instructors do not want grades displayed, others feel that this promotes competition among students. In example "A" only the final grade is shown. In "B" a lab grade "87", written grade "94" and final grade "91" are all shown. In example "C" a code has been used to signify the level of proficiency acquired by the student.

Method 3

Some tasks require that a student do them a certain number of times or for a certain period of time. In this case, progress may be kept by marking and shading a block.



In the progression shown above, an operation that requires four repetitions is shaded in the manner shown. The student's progress is from left to right with one fourth of the area being shaded on each performance.

This method provides the instructor with a quick reference from which to assign live work as it comes in.

Method 4

Many tasks in vocational education are divided into different proficiency levels. All of this information--the beginning and end and the learning phases of a task--can be coded in the same area on a progress chart. First look at the information to be shown:

1. Date learning of skill began
2. Date basic skill was learned
3. Performed successfully on shop receiver
4. Performed successfully on live customer receiver

The following sequence shows how this might be accomplished:

Task started on 3/1

Learning phase completed 3/17

Work on first plate completed

From 1 to 4 drawings completed

If only one is required, you may blacken the whole box. If more than one is required, you may show them by marking in only part of the box at the end of each job.

There are many other system which can be used. You should select the one which best fits your needs.

APPENDIX A. TEXT LISTING

TEXT TITLE	ABBREV.	NO.	AUTHOR	EDITION	PUBLISHER
Electronics Assembly and Fabrication Methods	EAFM	1	Duarte & Duarte	2nd	McGraw-Hill
How to Make Printed Circuit Boards	PCB	2	Goldberg	1st	McGraw-Hill
Understanding Radio Electronics	URE	3	Kaufman, Watson, Welch & Eby	4th	McGraw-Hill
Electricity-Electronics Fundamentals (text-lab manual)	EEF	4	Zbar & Sloop	2nd	McGraw-Hill
How to Select and Install Antennas	HSIA	5	Lon Carter	2nd	Hayden
Basic Television	BT	6	Grob	4th	McGraw-Hill
Basic Television (labmanual)	BTL	7	Zbar & Orne	3rd	McGraw-Hill
Transistor Radio Servicing	TR	8	Wayne Lemons	2nd	Sams
Introduction to Television Servicing	ITS	9	Brandenburg	1st	McGraw-Hill
Activities Manual for Introduction to Television Servicing	MITS	10	Brandenberg	1st	McGraw-Hill
Television Symptom Diagnosis	TSD	11	Richard Tinnell	2nd	Sams
Television Sympton Diagnosis (student manual)	TSDS	12	Richard Tinnell	2nd	Sams

Tape Recorder Servicing Guide	TRSG	13	R. Middleton	2nd	Sams
Record Changer Servicing Guide	RCSG	14	R. Middleton	2nd	Sams
Audio Servicing	AS	15	A. Wells	1st	McGraw-Hill
Audio Servicing (text-lab manual)	ASL	16	A. Wells	1st	McGraw-Hill

APPENDIX B. LIST OF REFERENCES

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References for Program Operation

Installing and Operating An Individualized Instruction Program Vocational Media Center, Georgia State Department of Education, June, 1978.

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APPENDIX C. READING LEVEL AND COMPUTATIONAL SKILLS

Reading Level. The texts used in Electronics/Radio/Tv are designed by the publishers for high school and post-secondary use. However, many of the references and advanced texts are written at a higher reading level. The student should be made to realize that future advancements in the field will depend upon his/her ability to read and interpret new materials and manuals published by equipment manufacturers.

Computational Skills:

In the electronics cluster students will need to be proficient in the following mathematical skills.

Add, subtract, multiply and divide

1. whole numbers
2. fractions
3. decimal numbers

Convert fractions to decimals. Convert decimals to fractions. Use of ratio and proportion. Solution of simple equations.

In radio and television certain other skills may be necessary.

Solution of more advanced equations
Use of trigonometric functions and tables